Journal of Coaching and Sports Science
Volume 5, Issue 2, 126-138.
e_ISSN: 2963-1483
https://www.journal.foundae.com/index.php/jcss/index
DOI: 10.58524/jcss.v5i2.1271

Effects of team competition-based training on petanque pointing accuracy among university athletes

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Article Info

Article history:
Received: February 24, 2026
Revised: April 3, 2026
Accepted: June 18, 2026

Keywords:
Competition-based training;
Motor learning;
Petanque;
Pointing accuracy;
Precision sport.

Abstract

Background: Pointing accuracy is a central performance skill in petanque because successful pointing determines boule proximity to the jack and shapes scoring opportunities during match play. However, conventional university practice often emphasises isolated technical repetition, whereas competition requires accuracy under time, peer, and outcome pressure.
Purpose: This study compared Team Competition-Based Training (TCBT) with Standard Training (ST) for improving petanque pointing accuracy among university athletes.
Methods: A course-based quasi-experimental pretest-posttest control-group design was implemented with 50 students. Participants were allocated to TCBT (n = 25) or ST (n = 25). Both groups completed 16 structured sessions over eight weeks. The technical content, duration, equipment, and training frequency were matched; only the organisational format differed. Pointing accuracy was measured at 6 m using a 0-15 scoring protocol.
Results: Both groups improved significantly from pre-test to post-test. The TCBT group improved from 2.32 +/- 1.35 to 7.40 +/- 1.47, whereas the ST group improved from 2.24 +/- 1.30 to 6.20 +/- 1.38. The post-test between-group difference favoured TCBT, t(48) = 2.969, p = .005, mean difference = 1.20 points, 95% CI [0.39, 2.01], Cohen's d = 0.84.
Conclusion: Within the limits of a single-university sample and an immediate post-test design, TCBT produced greater short-term improvement in pointing accuracy than ST. The findings support the cautious integration of competition-like team formats into university petanque training.

To cite this article: Nasution. M. F. A., Junaidi. J., Widyaningsih. H. (2026). Effects of team competition-based training on petanque pointing accuracy among university athletes. Journal *of Coaching and Sports Science, 5*(2), 126-138. https://doi.org/10.58524/jcss.v5i2.1271

INTRODUCTION

Petanque is a target-precision throwing sport in which athletes attempt to place steel boules closer to the jack than their opponents. Although the basic objective appears simple, successful performance requires a combination of technical control, tactical judgement, and situational awareness. In this performance context, pointing accuracy is not merely a basic technical action; it is a tactical skill that helps athletes control scoring positions, pressure the opposing team, and create favourable end-game situations. A well-executed pointing throw can shift the tactical balance of an end, restrict the opponent's scoring options, and allow a team to manage risk more effectively during match play. Because of this tactical importance, pointing accuracy has become a relevant focus in contemporary petanque research. Recent studies have examined pointing accuracy, biomechanical movement patterns, and physical determinants such as hand-eye coordination, arm characteristics, static balance, and grip-related variables (Irawan et al., 2022; Effendi et al., 2024; Helmi et al., 2024; Nurhasan et al., 2024b; Pratama et al., 2024). These studies have helped clarify several physical and technical factors associated with petanque performance. However, they do not fully explain how training should be organised to enable athletes to reproduce accurate pointing under realistic competitive conditions.

This gap is also visible in broader reviews of the petanque literature. Bibliometric and systematic reviews show that petanque research has grown in recent years, reflecting the increasing academic and practical interest in the sport (Hafidz et al., 2024a; Hafidz et al., 2024b; Nurhasan et al., 2024a; Pelana et al., 2025). Nevertheless, much of the available evidence still concentrates on physical characteristics, descriptive performance variables, or general development trends. Comparatively fewer studies have

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examined controlled differences between training formats, particularly whether the organisation of practice itself can influence pointing accuracy. As a result, coaches have limited empirical guidance when deciding whether technical repetition, competitive simulation, or hybrid formats should be prioritised in university-level petanque training.

A practical problem, therefore, remains for university-level coaching. Athletes may become technically familiar with pointing in low-pressure drills, yet still struggle when their throws contribute to a visible team score. This situation suggests that technical competence developed in isolated practice may not automatically transfer to competitive execution. In actual match conditions, the same pointing action is performed within a changing tactical environment. Athletes must consider the score, the opponent's boule placement, teammates' expectations, and the consequences of success or failure. These additional demands may alter attention, movement control, confidence, and decision-making during the throw. Competition changes the perceptual, cognitive, and affective demands of the same motor action. Athletes must execute throws while monitoring opponents, teammates, the score, and peer evaluations. Current evidence from sport psychology indicates that competitive pressure and pre-competition anxiety can affect athlete behaviour and performance regulation, although the size and direction of these effects depend on coping, appraisal, resilience, and task demands (Grove et al., 2025; Li et al., 2025; Nogueira et al., 2025). For petanque, this suggests that accuracy training should not be limited to mechanical repetition alone. Training environments should also expose athletes to the kinds of pressure, feedback, and decision constraints that are likely to occur during competition.

The theoretical justification for Team Competition-Based Training (TCBT) draws on the motor learning and motivation literature. Contextual interference research suggests that variable, cognitively demanding practice may support retention or transfer, but contemporary meta-analyses caution against broad claims because effects differ between laboratory and applied sport settings (Ammar et al., 2023; Ammar et al., 2024; Ammar et al., 2025; Czyz et al., 2024a; Czyz et al., 2024b). This caution is important because applied sport training involves complex interactions among task difficulty, athlete skill level, feedback, motivation, and practice structure. Therefore, contextual interference should not be treated as a universal solution. Instead, it provides a useful theoretical basis for designing practice that encourages athletes to adapt their movements under changing task conditions.

Game-based and small-sided approaches provide another relevant foundation for TCBT. These approaches show that representative, competitive practice can improve decision-making, adaptability, and skill execution in several sport contexts, although effects are moderated by task design and athlete characteristics (Bonney et al., 2022; Manninen et al., 2025; Zulaini et al., 2025). In precision-oriented settings, evidence from golf and visuomotor training further supports the potential value of representative task demands, feedback, and attentional regulation (Harris et al., 2024; Jin, 2025). These findings are relevant to petanque because pointing accuracy depends not only on repeated movement execution but also on the athlete's ability to regulate attention, adjust force, interpret spatial conditions, and perform under evaluative pressure.

TCBT was designed to translate these principles into practice for petanque pointing. Instead of asking athletes to complete only individual repetitions, TCBT places the same pointing tasks into 3v3 competition formats with visible scoring, peer accountability, rotating targets, and team-based reflection. In this structure, athletes still practise the technical components of pointing, but in a social and competitive environment that more closely resembles match conditions. The visible team score creates relevance to outcomes, while rotating targets requires athletes to adjust their throwing force, trajectory, and spatial judgement. Team-based reflection also encourages athletes to evaluate not only whether a throw was successful, but why it succeeded or failed within a tactical context.

The format is also compatible with self-determination theory because team scoring and shared goals may support relatedness and engagement, while structured feedback may support perceived competence (Li et al., 2024; Luarn et al., 2023). Social learning mechanisms are also relevant because athletes observe teammates and opponents, compare strategies, and receive multiple sources of performance information during practice (Reed et al., 2023). These mechanisms distinguish TCBT from Standard Training (ST), which typically emphasises coach-directed individual repetition and technical correction. While ST remains useful for developing basic movement consistency, it may offer fewer opportunities for athletes to engage in peer comparison, tactical adaptation, competitive pressure, and team responsibility during pointing practice.

The present study, therefore, compared the immediate effects of TCBT and ST on petanque pointing accuracy among university athletes. The study was guided by the following hypothesis: athletes receiving TCBT would show higher post-test pointing accuracy than those receiving ST, after controlling for training content, duration, session frequency, and equipment. The contribution of the study is deliberately bounded: it tests a short-term university training intervention. It does not claim evidence for elite competition performance, long-term retention, or psychological mediation. By keeping the technical content and practice dosage comparable across groups, the study focuses specifically on whether the organisational format of training can influence immediate pointing-accuracy outcomes in a university petanque context.

METHOD

Research Design

A quasi-experimental pretest-posttest control-group design was used in an intact university course setting. The design is described as quasi-experimental because the participant pool was a naturally formed elective-course cohort, even though participants were allocated to TCBT and ST within that cohort. This label avoids overstating the study as a fully randomised clinical-style trial and reflects the practical constraints of educational sport-training research. Testing occurred before and immediately after the 16-session intervention. Both groups trained during the same academic period, used the same facility and equipment, and received the same total training time. The main design contrast was the organisational format of practice: competitive team play in TCBT versus coach-directed individual drilling in ST. Consistent with current sport-science reporting recommendations, the study reports effect sizes and compatibility intervals rather than relying solely on p-values (Abt et al., 2025; Mesquida et al., 2023).

Participants

The participants consisted of 50 students. Participants were allocated to TCBT (n = 25) or ST (n = 25) using sealed envelopes. Inclusion criteria were active enrolment in the course, medical clearance for unrestricted physical activity, and commitment to attend the intervention sessions. Students with a current throwing-related injury or formal high-level petanque coaching certification were excluded. Baseline scores were similar between groups, $t(48) = 0.23$, $p = .82$, indicating no detectable pre-test difference in pointing accuracy. Nevertheless, the single-institution sample should be interpreted as a course-based training sample rather than as a representative sample of Indonesian or international petanque athletes.

Training sessions were conducted at the petanque facility of Universitas Negeri Medan. The facility included compacted gravel terrains suitable for structured petanque practice. The same regulation-sized boules, jacks, throwing circles, measuring tapes, chalk/flour zone markers, scoreboards, and timing devices were used for both groups to minimise equipment-related confounding. In the measurement instrument and testing protocol, pointing accuracy was assessed at a fixed distance of 6 m using a three-boule scoring protocol. Each throw was scored by the boule's proximity to the jack using a 5-3-1-0 annular zone system, yielding a maximum possible score of 15 points per administration. This short-distance pointing test was selected because it captures foundational pointing control and is consistent with recent petanque studies that use structured distance-based testing to evaluate accuracy-related performance (Irawan et al., 2022; Nurhidyat et al., 2024; Phytanza et al., 2022).

A pilot test-retest procedure was conducted with a comparable student cohort (N = 15) not included in the main study. Two administrations were separated by 72 hours and conducted under identical conditions. The test-retest reliability coefficient was ICC = 0.754. In the revised manuscript, this value is interpreted cautiously as acceptable for a field-based sport-skill protocol, while acknowledging that ICC alone does not fully quantify measurement error or rule out systematic testing effects (Warneke et al., 2025). Two trained assessors completed a pre-study scoring calibration, and the same assessor team administered pre-test and post-test sessions. During testing, the athlete stood inside the throwing circle, delivered three boules toward the jack, and paused approximately 15 seconds between throws. The evaluator recorded each boule score according to the marked scoring zones. The same terrain, time-of-day window, assessor team, equipment, and scoring procedure were used for both the pre-test and post-test.

Training intervention protocol: Both groups completed 16 training sessions over eight weeks. Sessions were scheduled twice weekly with at least 72 hours between sessions. Table 1 summarises the

standardised session structure that applied to both groups before the training formats diverged in the main training phase.

Table 1. Standardised session structure applied across all 16 training sessions

Phase	Duration	Content
Warm-up	15 min	5 min easy jogging and dynamic mobility, followed by 10 min boule-ndling, grip familiarisation, pendular swing rehearsal, and short underarm ows without scoring pressure.
Main training	60 min	Three 20 min pointing-throw models. TCBT performed the models in a m-competition format; ST performed technically equivalent tasks as coach-ected individual drills.
Cool-down and debrief	15 min	Static stretching and guided reflection. TCBT emphasised team score iew and collective decision reflection; ST emphasised individual technical rection and next-session targets.

Table 1 confirms that training time, warm-up, cool-down, and general technical content were held constant across conditions. Therefore, the comparison focused on whether the same pointing content produced different outcomes when organised as team competition rather than individual drilling. Team competition-based training group, the TCBT group trained in stable three-player teams. Each session embedded pointing practice into visible 3v3 team contests. Teams rotated opponents across sessions to preserve variety while retaining peer accountability. The coach monitored safety, explained task constraints, and facilitated post-task reflection, but did not interrupt every throw with prescriptive technical correction. Model 1, Rotational Accuracy Pointing Competition, required teams to point from the throwing circle toward targets repositioned at distances of 6 m. Athletes adjusted force, release timing, and trajectory as target orientation changed. Model 2, Target-Zone Team Competition Pointing, used target rings at 5, 6, and 7 m. Teams accumulated points across progressive distances. Model 3, Full-Layout Sequential Pointing Competition, used multiple scoring zones distributed across the playing area and required sequential target selection under team-score pressure. These models were intended to combine technical repetition with representative perceptual and social demands.

The standard training group ST group) received technically equivalent pointing content through coach-directed individual practice. Athletes trained individually rather than as teams. The coach evaluated the quality of execution and provided corrective feedback on grip pressure, backswing rhythm, release timing, trajectory, and follow-through. Model ST1 used fixed-distance repetition at 6 m. Model ST2 used progressive-distance drilling at 5, 6, and 7 m with advancement based on technical adequacy. Model ST3 used technical refinement with video feedback from a lateral camera position. This comparison was intentionally designed so that ST represented a serious conventional coaching condition rather than a weak control condition. Table 2 consolidates the operational differences between TCBT and ST.

Table 2. Comparative overview of TCBT and ST model structures across all 16 intervention sessions

Model	Time	TCBT format	ST format
Model 1	20 min	3v3 rotational pointing competition at approximately 6 m. Visible team score. Peer observation and outcome pressure maintained.	Individual fixed-distance repetition at 6 m. Coach feedback after each three-throw set. No competitive team score.
Model 2	20 min	3v3 progressive-distance competition at 5, 6, and 7 m. Cumulative team score across distances.	Individual progressive-distance drilling at 5, 6, and 7 m. Criterion-based advancement based on technical execution.
Model 3	20 min	Sequential multi-zone team competition. Target order and spatial configuration changed across attempts. Team strategy discussed.	Individual technical refinement at 6 m with video review and coach correction. Focus on grip, backswing, release, and follow-through.
Debrief	15 min	Collective performance review, team-score summary, and team reflection on tactical and technical decisions.	Individual technical-error review and coach-prescribed improvement targets for the next session.

Table 2 shows that the intervention contrast was not the amount of practice but the ecology of practice. TCBT added opponent presence, shared scoring, and team accountability; ST maintained individual repetition, coach feedback, and technical correction.

Data Analysis

Descriptive statistics were calculated for pre-test and post-test scores. Normality was assessed using Shapiro-Wilk tests, and homogeneity of variance was assessed using Levene's test. Within-group changes were analysed with paired-samples t-tests. Post-test differences between groups were analysed using an independent-samples t-test. The post-test mean difference was reported with a 95% confidence interval. Cohen's d was calculated for the between-group post-test difference, and dz was calculated for within-group change. Normalised gain was also reported as a supplemental descriptive index because gain-based comparisons can be useful but should be interpreted with caution when baseline scores are low or when scales have fixed ceilings (Christman et al., 2024). The analysis plan, therefore, emphasised converging evidence from descriptive change, inferential testing, and practical magnitude.

RESULTS AND DISCUSSION

Results

Descriptive Statistics

Table 3 presents the pre-test and post-test pointing accuracy scores for both groups. The pre-test means were nearly identical, while post-test scores increased in both conditions.

Table 3. Descriptive statistics for pre-test and post-test pointing accuracy scores

Group	Test	Mean	SD	Min	Max
TCBT	Pre-test	2.32	1.345	0	5
TCBT	Post-test	7.40	1.472	4	10
ST	Pre-test	2.24	1.300	0	5
ST	Post-test	6.20	1.384	3	9

The descriptive pattern indicates improvement in both groups, with a larger mean gain in the TCBT group. Because descriptive means alone cannot establish whether the difference is statistically reliable, inferential tests are reported in the following subsections. Figure 1 visualises the mean pre-test and post-test scores with standard deviation bars. The figure is included to provide a transparent visual counterpart to the descriptive values in Table 3.

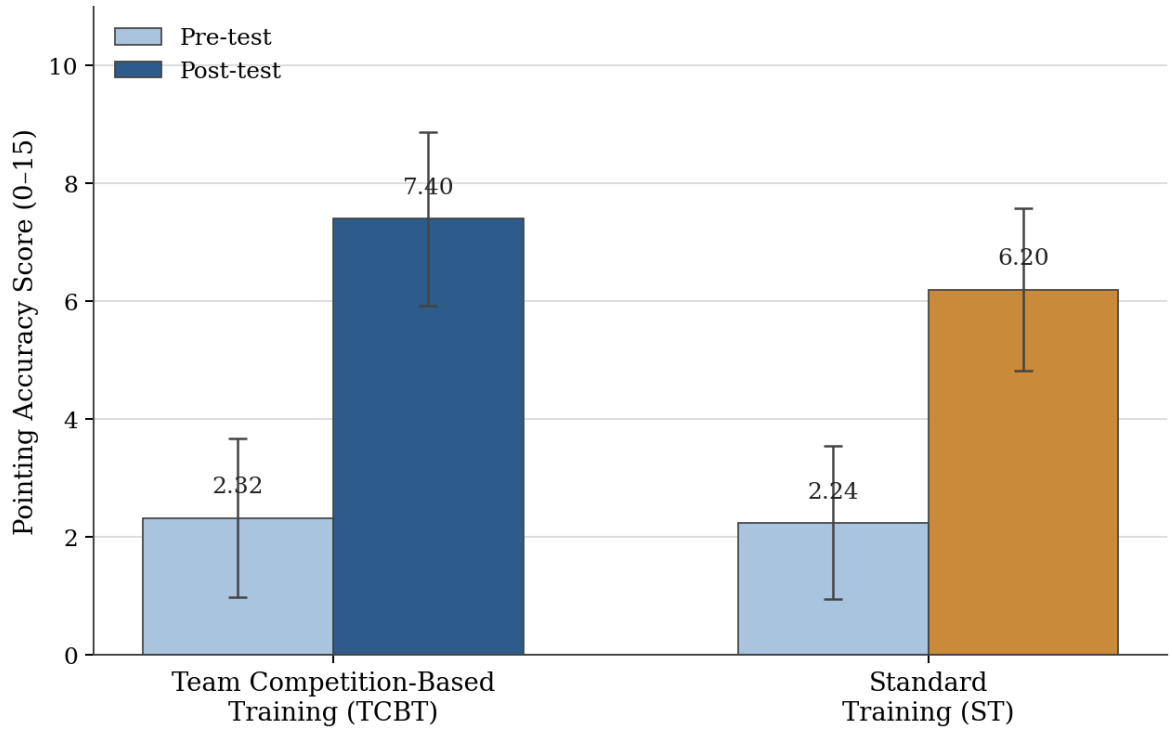

Figure 1. Pre-test and post-test pointing accuracy scores by group

Figure 1 shows that both training formats were associated with immediate improvement. The separation between post-test bars indicates the practical direction of the between-group result, with TCBT showing the higher mean post-test score.

Assumption Testing

Table 4 reports Shapiro-Wilk normality results for each pre-test and post-test distribution. All p-values exceeded .05, supporting the use of parametric tests for the planned comparisons

Table 4. Shapiro-Wilk test of normality results

Group	Test	Statistic	df	Sig.
TCBT	Pre-test	.930	25	.085
TCBT	Post-test	.944	25	.179
ST	Pre-test	.929	25	.084
ST	Post-test	.949	25	.240

The normality results should not be read as proof of a perfectly normal distribution; they indicate no statistical evidence of serious non-normality in these samples. The next assumption check concerns the equality of between-group variances. Table 5 reports Levene's test for homogeneity of variances. The mean-based test was non-significant, indicating that the equal-variance version of the independent-samples t-test was appropriate.

Table 5. Levene's test of homogeneity of variances

Basis	Levene statistic	df1	df2	Sig.
Based on the mean	.346	1	48	.559
Based on the median	.311	1	48	.580
Based on the median with adjusted df	.311	1	47.441	.580
Based on the trimmed mean	.318	1	48	.576

Together, Tables 4 and 5 support the planned parametric analyses. The assumption checks also improve transparency by showing why paired and independent-samples t-tests were retained.

Within-Group Improvement

Table 6 summarises the paired-samples t-tests used to examine pre-test-post-test change within each condition. Both groups improved significantly over the intervention period.

Table 6. Paired-samples t-test results for within-group improvement

Comparison	Mean diff.	t	df	p	dz
TCBT pre-test - post-test	-5.080	-31.265	24	< .001	6.25
ST pre-test - post-test	-3.960	-26.944	24	< .001	5.39

Table 6 confirms that structured practice improved pointing accuracy in both formats. The larger mean change in TCBT suggests a stronger immediate training response, but the key hypothesis concerns the post-test difference between groups.

Between-Group Comparison

Table 7 reports the independent-samples t-test comparing post-test scores. The equal-variance line is the primary result because Levene's test was non-significant.

Table 7. Independent-samples t-test result for post-test pointing accuracy

Assumption	Mean diff.	t	df	p	95% CI	Cohen's d
Equal variances assumed	1.200	2.969	48	.005	[0.39, 2.01]	0.84
Equal variances not assumed	1.200	2.969	47.821	.005	[0.39, 2.01]	0.84

The post-test comparison favoured TCBT by 1.20 points on the 0-15 scale. The confidence interval remained above zero, supporting the interpretation that TCBT produced a meaningful immediate advantage over ST in this sample.

N-Gain Score Analysis

Table 8 presents normalised gain values as a supplemental descriptive analysis. The metric expresses improvement relative to the maximum possible improvement from baseline.

Table 8. Normalised gain score results

Group	N-gain mean (%)	Min (%)	Max (%)	Descriptive category
TCBT	40.40	23.08	54.55	Medium
ST	31.25	20.00	41.67	Medium

Both groups fell within the same broad descriptive category, but the TCBT mean was higher, and its upper range extended further. Because N-gain can be affected by low starting scores and scale ceilings, this result is treated as supportive rather than decisive. Figure 2 visualises the N-gain comparison and includes minimum-to-maximum whiskers for each group. The dashed line is provided only as a descriptive reference threshold, not as a formal inferential boundary.

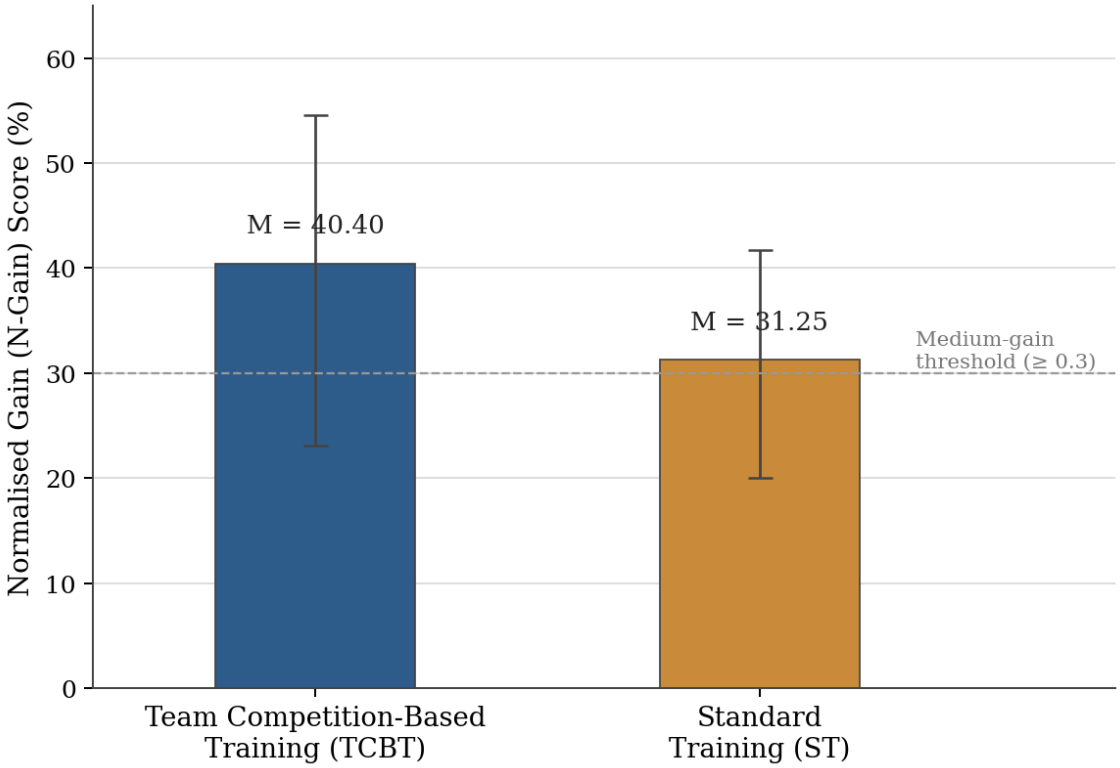

Figure 2. Normalised gain comparison between TCBT and ST

Figure 2 reinforces the pattern reported in Table 8: TCBT produced greater normalised improvement, while ST also showed an observable gain. The figure does not replace the t-test result but helps readers judge practical magnitude.

Effect-Size Visualisation

Figure 3 summarises the practical magnitude of the post-test difference using the mean difference, confidence interval, and Cohen's d. Unlike the previous version of the manuscript, no simulated individual-level trajectories are shown because raw per-athlete data were not available for publication-ready reconstruction.

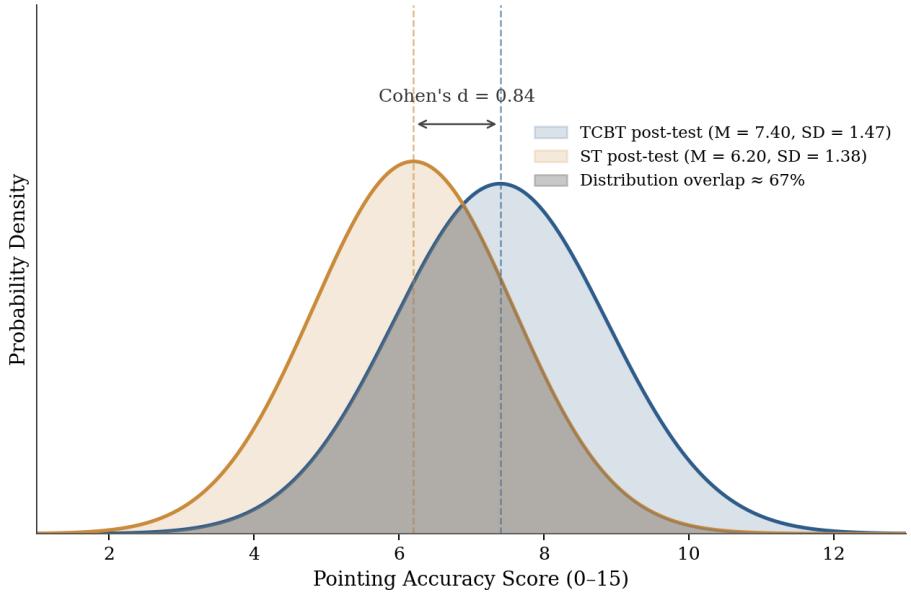

Figure 3. Post-test effect magnitude favouring TCBT

Figure 3 keeps the visualisation grounded in reported aggregate statistics. The effect-size display supports the conclusion that the between-group difference is practically meaningful while avoiding any implication that reconstructed individual data represent the original raw dataset.

Discussion

The results indicate that TCBT produced greater immediate improvement in petanque pointing accuracy than ST among university athletes in this course-based sample. Both groups improved, which is unsurprising, as they received structured, repeated pointing practice over the same intervention period. This confirms that systematic exposure to pointing tasks, whether delivered through competitive or standard formats, can support short-term technical development. However, the important finding is that the same technical content yielded a higher post-test score when embedded in team competition than when delivered through individual coach-directed drilling.

This difference suggests that training organisation may be an important performance-related variable in university petanque instruction. In the present study, the two groups were not differentiated by total training time, session frequency, equipment, or broad technical focus. Instead, the main distinction was how practice was structured: TCBT placed pointing tasks inside a competitive 3v3 format, whereas ST maintained a more conventional individual-drill structure. Therefore, the observed post-test advantage should be interpreted as evidence that the competitive organisation of practice may enhance immediate pointing outcomes when the technical content is otherwise comparable.

A cautious motor-learning interpretation is appropriate. TCBT increased task variability, opponent presence, team scoring, and outcome relevance. These features are consistent with contextual interference and representative-practice principles, but current meta-analytic evidence does not support universal claims that higher interference is always superior in applied sport settings (Ammar et al., 2024; Ammar et al., 2025; Czyz et al., 2024a; Czyz et al., 2024b). The present data, therefore, support a narrower claim: in this immediate post-test university petanque context, a well-structured competition-based format outperformed a technically equivalent standard format.

The TCBT format may have encouraged athletes to adapt their pointing execution across more variable and meaningful task conditions. Unlike isolated drilling, team competition required athletes to respond to shifting target positions, visible scores, opponents' performance, and teammates' expectations. These conditions may have increased attentional engagement and forced athletes to make more deliberate adjustments in force control, release timing, trajectory selection, and spatial judgement. Such demands are relevant to petanque because pointing is rarely performed in a neutral environment during actual play; it is typically done under tactical and social constraints that shape how athletes perceive and execute the throw.

The findings also align with evidence on game-based and small-sided sport training. Bonney et al. (2022) reported that small-sided competitive practice improved skill adaptability in Australian football,

while Manninen et al. (2025) found that game-based approaches can support decision-making and motor-skill outcomes across studies. Similar applied patterns have been reported in futsal and golf training, where representative and game-like constraints shape agility, tactical awareness, and skill development (Jin, 2025; Zulaini et al., 2025). TCBT adapts these ideas to petanque by preserving technical pointing repetitions while adding match-like social and scoring constraints.

Psychological mechanisms are plausible but were not directly measured. Competition-like practice may expose athletes to peer observation, visible consequences, and moderate pressure, all of which can affect concentration and the quality of execution. Contemporary sport-psychology evidence suggests that pressure, anxiety, appraisal, resilience, and coping are interrelated rather than simple one-directional causes of performance decline (Grove et al., 2025; Li et al., 2025; Nogueira et al., 2025). The current study, therefore, should not claim that TCBT improved psychological resilience; it can only suggest that the competitive structure may have contributed to more representative practice conditions.

The social structure of TCBT may also have supported learning through observation, comparison, and shared responsibility. In a team-competition format, athletes do not merely repeat throws for individual correction; they watch teammates and opponents, evaluate tactical decisions, and experience the consequences of each attempt within a collective score. This may create richer feedback than coach-directed correction alone, because performance information comes from the coach, the score, the opponent's response, and the team's collective reflection. However, this explanation remains inferential because the study did not directly measure peer interaction, motivation, attentional focus, or perceived pressure during practice.

The petanque-specific contribution is that the study shifts attention from performance correlates to training design. Recent petanque literature has identified physical and biomechanical factors related to pointing and shooting, including hand-eye coordination, arm characteristics, joint movement patterns, and balance-related variables (Effendi et al., 2024; Helmi et al., 2024; Irawan et al., 2022; Nurhasan et al., 2024b; Pratama et al., 2024). Those findings help explain what capacities matter. The present study complements that literature by examining how the same pointing skill can be organised in training to produce different short-term gains.

The result is also consistent with recent petanque intervention studies showing that accuracy-focused, target-based, imagery-based, and structured practice can improve technical outcomes (Abdurrahman et al., 2024; Abdullah et al., 2024; Nurhidyat et al., 2024; Phytanza et al., 2022). However, the present study differs in that it directly compares two organisational formats while holding time and technical content constant. This makes the training format itself the most plausible explanation for the observed post-test difference, although unmeasured motivational and peer-interaction variables remain possible mediators. Future studies should therefore include psychological, behavioural, and process-level measures to determine which elements of TCBT are most responsible for performance improvement.

For coaches, TCBT offers a low-cost way to redesign existing practice. It does not require additional terrains or advanced equipment; it requires clearer scoring rules, team rotation, time control, and structured debriefing. Digital performance tools for petanque may further strengthen this approach by recording match statistics and supporting coach feedback during team-based practice (Hidayah et al., 2024; Putra et al., 2024). Periodisation principles remain relevant: competition-like sessions should be integrated progressively rather than replacing all technical refinement sessions (Martin Dantas et al., 2022). In practical terms, TCBT should be viewed as a complementary training organisation that can make technical practice more representative, socially engaging, and tactically meaningful. At the same time, ST remains useful for focused technical correction and early-stage skill refinement.

Research Contributions

This study contributes to the petanque and motor-learning literature by shifting the analytical focus from identifying physical and biomechanical correlates of performance to examining how the organisational structure of practice influences skill development. By comparing Team Competition-Based Training (TCBT) with technically equivalent Standard Training while controlling training duration, frequency, equipment, and task content, the study provides evidence that competition-like team organisation can generate greater immediate improvements in university athletes' pointing accuracy. The findings extend representative-practice, contextual-interference, social-learning, and motivational perspectives into a precision-sport context that remains underrepresented in intervention research. Practically, the study offers coaches and university instructors a feasible, low-cost training model that

integrates visible scoring, opponent presence, peer accountability, task variability, and collective reflection without replacing fundamental technical instruction. Methodologically, the study also demonstrates the value of isolating training organisation as an intervention variable rather than comparing substantially different training contents. Nevertheless, the contribution remains bounded to short-term pointing performance in a university setting and should be further examined through retention, transfer, psychological, and competition-based outcomes.

Limitations

Several limitations should guide interpretation. First, the sample was drawn from one university course cohort, limiting generalisability. Second, the study measured only immediate post-test pointing accuracy; it did not include retention testing or actual tournament match statistics. Third, the study did not measure psychological pressure, anxiety, motivation, or the quality of peer interactions, so the proposed mechanisms remain theoretical. Fourth, the reliability analysis reported ICC but did not include the standard error of measurement, limits of agreement, or minimal detectable change. Fifth, assessors were not explicitly reported as blinded to group allocation.

Suggestions

Future studies should use larger, multi-institutional samples, retention and transfer tests, blinded assessment, raw trajectory reporting, and multidimensional outcomes, including shooting accuracy, tactical decision-making, biomechanical measures, psychological profiles, and digital match statistics. Experimental work should also examine how best to sequence TCBT alongside individual technical training over a full season.

CONCLUSION

Team Competition-Based Training produced a greater immediate improvement in petanque pointing accuracy than Standard Training among university athletes following a 16-session intervention, with the post-test difference favouring TCBT by 1.20 points and representing a large practical effect. Because both groups received comparable technical content, training duration, frequency, and equipment, the findings indicate that the organisational ecology of practice—particularly team scoring, opponent presence, peer accountability, task variability, and competition-like pressure—may enhance short-term pointing development beyond individual coach-directed drilling alone. TCBT should therefore be considered a complementary rather than replacement approach, as conventional technical practice remains important for movement correction and foundational skill refinement. However, the conclusions are limited to one university cohort, a fixed-distance pointing test, and an immediate post-test; consequently, the study does not establish long-term retention, transfer to tournament performance, superiority among elite athletes, or the psychological mechanisms underlying the observed improvement. Future multi-institutional studies should incorporate retention and transfer assessments, blinded evaluation, match-performance indicators, and process measures such as motivation, anxiety, attention, and peer interaction.

ACKNOWLEDGMENT

The authors express their gratitude to the Doctoral Scholarship Program for Indonesian Lecturers, the Centre for Higher Education Funding and Assessment, and the Ministry of Higher Education, Science and Technology of the Republic of Indonesia. Appreciation is also extended to the Faculty of Sport Science, Universitas Negeri Medan, for institutional support, and to the students of the Sports Coaching Education programme who participated in this study.

AUTHOR CONTRIBUTION STATEMENT

MF, JJ, and HW collaboratively designed the study and developed the research framework. MF conducted data collection and performed the statistical analysis. JJ contributed to methodology design and supervised the research process. HW contributed to the literature review, interpretation, and manuscript drafting. All authors reviewed, revised, and approved the final manuscript.

AI DISCLOSURE STATEMENT

Generative AI was used as an editorial support tool for language refinement, citation screening, consistency checking, and formatting assistance during manuscript revision. The authors remain fully responsible for the accuracy, integrity, originality, interpretation, and final approval of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interest in relation to this article.

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