

Competitive Collective Variable Training to Improve Basketball Layup Shooting Accuracy

Ramy Jabbar Kazem Abboud

General Directorate of Education in Babylon, Iraq

Correspondent Author: ramy.Kazem.hphy40@student.uobabylon

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Abstract

Layup shooting accuracy is a critical basketball skill because successful scoring requires the integration of dribbling control, legal stepping, body balance, movement timing, and precise ball release under changing game conditions. This study aimed to examine the effect of a competitive collective method based on variable training on basketball layup shooting accuracy among fourth-year students. A quantitative experimental method with an equivalent control-group and experimental-group design was employed using pretest and posttest measurements. The participants were 36 fourth-year students at the College of Physical Education and Sports Sciences, University of Babylon, during the 2024-2025 academic year, divided equally into a control group and an experimental group, each consisting of 18 students. The instrument was a standardized layup shooting accuracy test consisting of 10 legal attempts. The experimental group received eight educational units over four weeks involving collective competition and variable layup practice from different angles and distances, while the control group followed the traditional instructional method. The results showed that the control group improved from 4.50 to 5.39, whereas the experimental group improved from 4.45 to 7.02. The posttest comparison indicated that the experimental group outperformed the control group, with a calculated t-value of 4.11. These findings demonstrate that competitive collective variable training is more effective than traditional instruction and can be used as a practical strategy for improving basketball layup shooting accuracy in university-level physical education.

Keywords: Competitive Method; Collective Method; Variable Training; Layup Shooting; Basketball.

INTRODUCTION

Physical education and sport science increasingly emphasize the design of learning environments that can connect movement competence, technical skill acquisition, and performance adaptability. This emphasis is particularly relevant in basketball because the game requires students and athletes to coordinate repeated high-intensity actions, rapid changes of direction, ball control, jumping, spatial awareness, and decision-making under unstable temporal and tactical conditions. Basketball performance is not produced only by isolated mastery of a movement pattern; it is shaped by how learners adapt that movement to changing competition demands. Research on youth basketball has shown that physical demands may vary across competition contexts, while kinematic parameters help explain player behavior according to positional and relative-age factors (Pino-Ortega et al., 2022; Salazar et al., 2021). Studies on training preparation also indicate that practice becomes more meaningful when it is coherent with competitive demands rather than separated from the realities of match play (Feu et al., 2023; Monteiro et al., 2024). Experimental training evidence further supports the view that structured basketball preparation can improve athletic ability and movement control, whereas heart rate and cortisol studies show that basketball activity may impose physiological and stress-related demands that require appropriate instructional management (Sánchez et al., 2021; Wang, 2022; Xu, 2023). From a neuro-motor perspective, basketball experience is associated with cortical changes related to motor skill and spatial perception, indicating that repeated sport-specific practice may influence the systems involved in skilled performance (Kim et al., 2022). Therefore, basketball learning in higher physical education should

be framed as an adaptive instructional process that develops accurate execution under variable and realistic performance constraints.

Within this broader context, layup shooting deserves specific pedagogical attention because it is a fundamental scoring action that requires coordination among dribbling, approach rhythm, legal stepping, body balance, body orientation, timing, and accurate ball release near the basket. Although the movement is often taught as a basic technique, its successful execution in game-like situations is affected by changing entry angles, distances, defensive pressure, available space, and the speed of offensive transition. Performance-analysis evidence shows that field-goal success in elite wheelchair basketball is influenced by offensive, defensive, and contextual variables, while shooting effectiveness across a competitive season may be shaped by match location, shot-clock conditions, and defensive pressure (Cavedon et al., 2023; Francis et al., 2021). Research on wheelchair basketball free throws further indicates that shooting accuracy is related to pre-shot routine duration and consistency of trunk movement, suggesting that stable accuracy depends on both technical and coordination-related factors (Shigematsu et al., 2022). Representative shooting-task research also shows that practice conditions reflecting performer-environment interactions can influence shooting technique and accuracy, making it inappropriate to treat shooting practice as a purely fixed repetition task (Court Gold et al., 2025). The urgency of the present study emerges from the observed learning context in which fourth-year students are expected to transfer previously learned basketball skills into more dynamic and competitive situations, but traditional instructional patterns may still provide predictable, fixed, and less game-representative practice. This problem is important because performance pressure, personal anxiety, and behavioral characteristics may affect basketball actions and performance-related outcomes (Siemon & Wessels, 2023; Vasilev & Iliev, 2024). Accordingly, the problem can be addressed by designing a learning strategy that combines repeated layup practice with variability and collective competition so that students practice accuracy under changing conditions rather than only under stable instructional routines.

Previous studies have provided important evidence that basketball performance can be improved through different training and instructional approaches, but the specific integration of collective competition and variable layup practice remains underexamined. For example, small-sided games with baskets have been reported to enhance neuromuscular force parameters more effectively than ball-possession games in young male basketball players, while individualized training based on dynamic strength index has been used to improve sprinting, jumping, and change-of-direction performance (Cao et al., 2024; Pleša et al., 2024). Periodized training has also been shown to improve physical-motor indicators and basketball-specific skills among young players, supporting the value of structured practice for measurable basketball outcomes (Lauria et al., 2021). Recent work using three-dimensional convolutional neural networks demonstrates that basketball technique actions can be recognized through spatiotemporal movement features, which indirectly reinforces the importance of accurate and consistent technical execution in basketball learning (Wang et al., 2024). In addition, school-based basketball research indicates that instruction is shaped by teacher competence, equipment access, gender-related preferences, and urban-rural teaching contexts, while after-school basketball programs have been associated with improvements in physical fitness and phonological fluency in children (Beťák et al., 2025; Campos-Jara et al., 2026). These studies show that basketball learning is affected by training design, instructional context, technological assessment, and learner engagement. However, they do not specifically test whether a university-level instructional program combining group competition with variable layup

attempts from different angles, distances, and movement paths can improve layup shooting accuracy more effectively than traditional instruction. The novelty of this study lies in its specific integration of collective competition and variable layup training within a university physical education context. Previous basketball studies have largely examined neuromuscular training, individualized physical conditioning, match-load demands, representative shooting tasks, and technology-based action recognition. However, limited evidence explains whether layup shooting accuracy can be improved through a structured instructional model that combines group-based competition with variable practice from different angles, distances, and movement paths. This study addresses that gap by testing a competitive collective variable training method specifically for fourth-year university students and measuring its effect on a clearly defined basketball scoring skill.

Based on this background and research gap, this study aimed to examine the effect of competitive collective variable training on basketball layup shooting accuracy among fourth-year university students. The independent variable was the instructional treatment, namely a competitive collective method based on variable training, while the dependent variable was layup shooting accuracy measured through a standardized test consisting of 10 legal layup attempts. The study focused on fourth-year students at the College of Physical Education and Sports Sciences, University of Babylon, during the 2024-2025 academic year, with 36 participants divided equally into an experimental group and a control group. The experimental group received eight educational units across four weeks, using collective competition and variable layup practice from different angles and distances, whereas the control group followed the traditional instructional method. The analytical direction of the study was limited to examining baseline equivalence, within-group pretest-posttest improvement, and between-group posttest differences in layup shooting accuracy. This scope means that the study did not examine other basketball skills such as passing, dribbling, jump shooting, defensive movement, tactical decision-making, psychological responses, long-term retention, or actual match performance. Nevertheless, the study is expected to contribute to basketball pedagogy by providing empirical evidence on whether a short, structured, competitive, and variable learning design can support improvement in a specific scoring skill within limited instructional time. The hypothesis was that students who received competitive collective variable training would demonstrate greater improvement in layup shooting accuracy than students who received traditional instruction.

METHODS

Research Design

This study used a quantitative approach with a quasi-experimental pretest-posttest control group design. This design was selected because the purpose of the study was to test the effect of a specific instructional treatment, namely the competitive collective method based on variable training, on a measurable motor-skill outcome: basketball layup shooting accuracy. A quasi-experimental design was appropriate because the participants were organized in existing academic sections rather than being individually randomized into treatment conditions. The design enabled the researcher to compare changes within each group from pretest to posttest and to compare posttest performance between the experimental group and the control group. Experimental and randomized controlled approaches are commonly used in basketball training research when the objective is to examine whether a structured program produces measurable improvement in physical, neuromuscular, or skill-related performance outcomes (Cao et al., 2024; Pleša et al.,

2024). In the present study, the experimental group received layup shooting practice through collective competition and variable practice conditions, while the control group followed the traditional instructional method used in the regular learning process. The use of variable practice was consistent with the nature of basketball as an open-skill sport, in which shooting performance is influenced by changing spatial, temporal, and task conditions. Previous basketball studies have emphasized the need to align training activities with competition demands and representative task conditions so that players can adapt technical execution to realistic game situations (Court Gold et al., 2025; Feu et al., 2023; Monteiro et al., 2024). The design of the study is presented in Table 1.

Table 1. Research design

Group	Pretest	Treatment	Posttest
Experimental group	Layup shooting accuracy test	Competitive collective method based on variable training	Layup shooting accuracy test
Control group	Layup shooting accuracy test	Traditional instructional method	Layup shooting accuracy test

Participants

The research subjects were fourth-year students at the College of Physical Education and Sports Sciences, University of Babylon, during the 2024-2025 academic year. The accessible research population consisted of fourth-year students enrolled in the basketball learning context. Two academic sections, Section B and Section C, were selected by lottery from the available fourth-year sections. Section B was assigned as the control group, and Section C was assigned as the experimental group. The total sample consisted of 36 students, with 18 students in each group. The available source document indicates that the sample was selected from the target learning context; therefore, the sampling procedure is best described as section-based selection with lottery assignment of available classes rather than full individual randomization. The inclusion criterion was active participation as a fourth-year student in the relevant basketball learning program. The exclusion criteria were: (1) students who experienced pain or injury that prevented correct execution of the layup shooting task, and (2) students classified as players in national teams or sports clubs, because advanced competitive experience could influence baseline skill level and reduce equivalence between groups. Before the intervention, the researcher examined sample homogeneity using age, height, and body mass, and examined group equivalence using the layup shooting accuracy pretest.

Table 2. Participant allocation and research groups

Group	Section	Number of participants	Role in the study	Instructional condition
Control group	B	18 students	Comparison group	Traditional instructional method
Experimental group	C	18 students	Treatment group	Competitive collective method based on variable training
Total	-	36 students	-	-

Instruments and Research Procedures

The main research instrument was a standardized layup shooting accuracy test used to measure the dependent variable, namely basketball layup shooting accuracy. The test required each participant to perform 10 legal layup shooting attempts after dribbling toward the basket and executing legal steps before releasing the ball near the basket. One point was awarded for each

successful and legally performed layup, whereas zero was given for an unsuccessful attempt or an attempt accompanied by a rule violation, such as travelling or double dribbling. The maximum possible score was 10 points. The research procedure began with a pilot experiment conducted on Sunday, March 24, 2024, involving eight students from the research population but outside the main sample. The pilot experiment was used to identify possible field obstacles, clarify test instructions, verify equipment readiness, estimate testing time, and ensure that the assisting team understood the measurement procedure. The pretest was administered at 9:00 a.m. on Tuesday, March 26, 2024, under controlled conditions using the same venue, equipment, and supporting team. The main intervention was implemented from Sunday, March 31, 2024, to Tuesday, April 30, 2024.

The experimental group received eight instructional units over four consecutive weeks, with two units each week. Fifteen minutes of the applied part of each instructional unit were allocated to the competitive collective variable training program. The treatment consisted of layup shooting exercises performed from different angles and distances in small-group competitive formats. This procedure was designed to expose students to varied execution conditions while maintaining repeated practice opportunities and competitive engagement. In basketball learning research, practice tasks that reproduce competition-related variability are considered relevant because physical and skill performance may be influenced by kinematic and contextual conditions (Pino-Ortega et al., 2022; Salazar et al., 2021). The control group followed the traditional instructional method during the same learning period. After the intervention, the posttest was conducted on Sunday, May 5, 2024, under the same conditions as the pretest.

Data Analysis

The data were analyzed quantitatively using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics were used to summarize the participants' basic characteristics and layup shooting accuracy scores. The mean was used to describe average performance, the standard deviation was used to describe score dispersion, the median was used as a supporting measure of central tendency, and the skewness coefficient was used to examine the distribution tendency of the basic variables. The researcher first examined homogeneity in age, height, and body mass, and then examined pretest equivalence between the control and experimental groups using an independent samples t-test. A paired samples t-test was used to compare pretest and posttest layup shooting accuracy within each group, while an independent samples t-test was used to compare posttest scores between the control and experimental groups. The significance level was set at 0.05. The interpretation criterion followed the rule that a calculated t-value greater than the tabular t-value indicated a statistically significant difference. Because the study used a pretest-posttest quasi-experimental design, the analysis focused on two forms of evidence: improvement within each instructional condition and superiority of one instructional condition over the other after the intervention.

RESULTS

The research data consisted of 36 fourth-year students from the College of Physical Education and Sports Sciences, University of Babylon. The participants were divided into two equal groups: a control group that followed the traditional instructional method and an experimental group that received competitive collective variable training. Each group consisted of 18 students. The independent variable was the instructional treatment, namely competitive collective variable

training compared with the traditional method, whereas the dependent variable was basketball layup shooting accuracy. Layup shooting accuracy was measured using a standardized field test consisting of 10 legal attempts, so the maximum possible score was 10 points. The source data reported complete group-level results for all 36 participants; no missing values were reported. However, individual raw scores, gender distribution, score frequencies, minimum and maximum scores, modes, and histograms were not provided in the source document. Therefore, the results below are limited to the available group-level descriptive and inferential statistics.

Table 3. Descriptive statistics of sample characteristics

Variable	N	Mean	Median	SD	Variance	Skewness
Age (years)	36	22.10	22.16	2.22	4.93	0.32
Height (cm)	36	172.30	171.16	1.38	1.90	0.11
Body mass (kg)	36	69.40	70.11	2.26	5.11	0.14

The descriptive statistics of the sample characteristics indicate that the participants had relatively homogeneous basic characteristics before the intervention. As shown in Table 3, the mean age was 22.10 years (SD = 2.22), the mean height was 172.30 cm (SD = 1.38), and the mean body mass was 69.40 kg (SD = 2.26). The reported skewness coefficients were 0.32 for age, 0.11 for height, and 0.14 for body mass. These values indicate that the available baseline characteristic distributions did not show strong asymmetry based on the reported group-level statistics. Among the three characteristics, body mass had the highest variance (5.11), followed by age (4.93), while height showed the lowest variance (1.90). These findings provide a descriptive basis for interpreting the subsequent group comparison because the participants were relatively similar in the reported physical characteristics before the main treatment was applied.

Table 4. Descriptive statistics of layup shooting accuracy by group and test stage

Group	Test stage	N	Mean	SD	Variance	Mean as % of maximum score	Mean gain from pretest
Control	Pretest	18	4.50	1.16	1.35	45.0%	-
Control	Posttest	18	5.39	1.60	2.56	53.9%	0.89
Experimental	Pretest	18	4.45	1.20	1.44	44.5%	-
Experimental	Posttest	18	7.02	1.12	1.25	70.2%	2.57

The descriptive statistics of layup shooting accuracy are presented in Table 4. At the pretest stage, the control group obtained a mean score of 4.50 (SD = 1.16), while the experimental group obtained a mean score of 4.45 (SD = 1.20). The two pretest means differed by only 0.05 points, indicating that both groups started from a nearly similar level of layup shooting accuracy. At the posttest stage, the control group increased to 5.39 (SD = 1.60), whereas the experimental group increased to 7.02 (SD = 1.12). The control group improved by 0.89 points, equivalent to 8.9 percentage points of the maximum test score. The experimental group improved by 2.57 points, equivalent to 25.7 percentage points of the maximum test score. The pattern of means shows that both groups improved after the instructional period, but the increase in the experimental group was larger than the increase in the control group. The experimental group also reached the highest final mean score, corresponding to 70.2% of the maximum possible layup shooting accuracy score.

A frequency distribution of individual layup shooting scores could not be presented because the source data did not report raw individual scores or score-by-score frequencies. Consequently, the most frequent score, percentage distribution, histogram, minimum score, maximum score, and

range could not be verified. The available distribution evidence is therefore limited to the reported means, standard deviations, variances, and skewness coefficients. Based on the available descriptive data, the main pattern is a clear upward shift in mean layup shooting accuracy from pretest to posttest in both groups, with a stronger shift in the experimental group. The posttest standard deviation of the experimental group ($SD = 1.12$) was slightly lower than its pretest standard deviation ($SD = 1.20$), indicating that the experimental group not only increased its mean score but also showed slightly reduced score dispersion after the intervention. In contrast, the control group's standard deviation increased from 1.16 at pretest to 1.60 at posttest, indicating greater dispersion in posttest performance within the control group.

Table 5. Initial equivalence test for layup shooting accuracy before treatment

Variable	Control group (M +/- SD)	Experimental group (M +/- SD)	Mean difference	t	df	p	Decision
Layup shooting accuracy	4.50 +/- 1.16	4.45 +/- 1.20	0.05	0.13	34	.900	Not significant

Before testing the treatment effect, the initial equivalence of the control and experimental groups was examined using the available pretest data. The results are presented in Table 5. The control group had a pretest mean of 4.50 ($SD = 1.16$), while the experimental group had a pretest mean of 4.45 ($SD = 1.20$). The recalculated independent-samples t-test produced $t(34) = 0.13$, $p = .900$. Because the significance value was greater than .05, the difference between the two groups at pretest was not statistically significant. This result indicates that the two groups were equivalent in layup shooting accuracy before the intervention. No Kolmogorov-Smirnov, Shapiro-Wilk, Levene, linearity, or multicollinearity statistics were reported in the source data. Therefore, no additional prerequisite test results are presented. Correlation and regression analyses were also not reported because the study design tested mean differences between an instructional treatment and a control condition rather than predictive relationships among multiple independent variables.

Table 6. Pretest-posttest comparison of layup shooting accuracy within each group

Group	Pretest (M +/- SD)	Posttest (M +/- SD)	Mean gain	Gain as % of maximum score	t	df	p
Control	4.50 +/- 1.16	5.39 +/- 1.60	0.89	8.9%	10.02	17	< .001
Exp.	4.45 +/- 1.20	7.02 +/- 1.12	2.57	25.7%	12.03	17	< .001

The within-group comparison showed that both groups improved from pretest to posttest. As shown in Table 6, the control group increased from 4.50 ($SD = 1.16$) to 5.39 ($SD = 1.60$), with a mean gain of 0.89 points. The reported paired-samples t-test for the control group was significant, $t(17) = 10.02$, $p < .001$. The experimental group increased from 4.45 ($SD = 1.20$) to 7.02 ($SD = 1.12$), with a mean gain of 2.57 points. The reported paired-samples t-test for the experimental group was also significant, $t(17) = 12.03$, $p < .001$. These results indicate that both instructional conditions were associated with statistically significant improvement in layup shooting accuracy. However, the magnitude of the mean gain was larger in the experimental group than in the control group. The experimental group's mean gain was 2.57 points, whereas the control group's mean gain was 0.89 points, showing that the experimental group gained approximately 1.68 more points than the control group on the 10-point layup shooting accuracy test.

Table 7. Posttest comparison between the control and experimental groups

Variable	Control group	Exp. group (M	Mean difference	t	df	p	Cohen d
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	(M +/- SD)	+/- SD)					
Layup shooting accuracy	5.39 +/- 1.60	7.02 +/- 1.12	1.63	3.54	34	.001	1.18

The posttest comparison between the control and experimental groups is shown in Table 7. The experimental group obtained a higher posttest mean score ($M = 7.02$, $SD = 1.12$) than the control group ($M = 5.39$, $SD = 1.60$). The mean difference between the two groups was 1.63 points in favor of the experimental group. The recalculated independent-samples t-test indicated a statistically significant posttest difference, $t(34) = 3.54$, $p = .001$. The effect size was Cohen $d = 1.18$, calculated from the reported posttest means, standard deviations, and sample sizes. This result shows that the experimental group outperformed the control group after the instructional period. Based on the available posttest data, the competitive collective variable training condition produced a higher final layup shooting accuracy score than the traditional instructional condition.

DISCUSSION

The initial equivalence of the control and experimental groups has an important methodological meaning because it indicates that the subsequent difference in layup shooting accuracy can be interpreted more reasonably as an effect associated with the instructional condition rather than as a consequence of unequal starting ability. In motor-skill intervention research, baseline comparability is essential because basketball performance is not determined only by technical knowledge but also by interacting anthropometric, motoric, biomechanical, and coordination-related characteristics. Studies on basketball players have shown that competition rank, playing position, body profile, lower-extremity kinematics, and comprehensive fitness indicators may differentiate performance capacity and movement outcomes (Cairns et al., 2024; Ding, 2025; Jòdar-Portas et al., 2023; Ljubojevic et al., 2023; Stanković et al., 2022; Szabó et al., 2025). The present finding is therefore consistent with the broader methodological need to examine initial physical and skill characteristics before interpreting intervention effects. However, the present study differs from those profiling studies because it did not aim to classify players by position, competition level, or biomechanical risk profile; instead, it used baseline testing to support the internal validity of a learning experiment. This difference is mainly due to the instructional focus of the study and the limited scope of available measurements. The weakness of this interpretation is that equivalence was confirmed only through age, height, body mass, and pretest layup accuracy, whereas other potentially relevant variables, such as previous basketball experience, lower-limb asymmetry, approach speed, balance, motivation, and decision-making quality, were not measured. The implication is that future instructional experiments should maintain the same baseline control procedure but expand it with more complete motor, biomechanical, and psychological indicators to strengthen causal interpretation.

The improvement observed in the control group suggests that traditional instruction can still support basic acquisition of layup shooting accuracy when learners receive structured practice within a formal physical education setting. This finding is meaningful because the layup is a sequential motor skill: students must coordinate dribbling, approach rhythm, legal stepping, take-off, body alignment, and ball release. Repeated exposure to the same technical sequence may help learners stabilize the movement pattern and reduce execution errors, especially at the early stage of skill refinement. This interpretation is compatible with evidence showing that direct instruction, deliberate practice, structured basketball training, and planned learning environments can improve

sport-specific skills, functional performance, and student engagement (Gallotta et al., 2025; González-Espinosa et al., 2021; Lima et al., 2020; Soares et al., 2020; Tymoshenko et al., 2021; Tymoshenko et al., 2022). The similarity lies in the role of organized practice as a condition for measurable motor improvement. Nevertheless, the control-group gain was smaller than the experimental-group gain, indicating that traditional repetition alone may be sufficient for basic improvement but less adequate for producing stronger adaptation to variable scoring conditions. This differs from studies using broader, longer, or more specialized interventions, such as inclusive basketball training, machine-assisted practice, or structured pedagogical comparisons, where improvements were supported by extended exposure or more varied learning tasks (Gallotta et al., 2025; González-Espinosa et al., 2021; Tymoshenko et al., 2022). The likely explanation is that the control group practiced under more predictable instructional conditions and did not receive systematic variation in angle, distance, and competitive peer pressure. A limitation is that the source document does not describe the exact content of the traditional method in detail. Practically, the result implies that traditional instruction remains useful but should be enriched with task variation when the learning target is accurate execution in game-like situations.

The larger improvement in the experimental group indicates that competitive collective variable training provided a stronger learning stimulus for layup shooting accuracy than ordinary instructional exposure. The pedagogical significance of this finding is that layup shooting is not merely a closed technical routine but a basketball scoring action that must be adapted to changing entry angles, distances, timing, movement paths, and social pressure created by opponents or teammates. Variable practice can encourage learners to reorganize their movement solutions, while collective competition can increase attention, effort, and repeated engagement. This interpretation is supported by intervention evidence showing that multidirectional training, simulation-based basketball training, variable resistance training, functional training, balance training, and resisted plyometric exercises can improve physical, neuromuscular, skill-related, or shooting-performance indicators when the training tasks are specific and systematically organized (Elgammal & Radwan, 2022; Javanmardi et al., 2021; Lin, 2023; Pamuk et al., 2022; Tyagi et al., 2024; Wang, Chen, et al., 2025; Wu & Huang, 2023). The present study is like those studies in treating basketball performance as a trainable outcome that improves through structured task demands. However, the present treatment differs because it focused narrowly on layup shooting accuracy in university students and used collective competition plus variable layup paths rather than general fitness, resistance, balance, or simulation-based programs. This difference may explain why a relatively short four-week intervention was able to produce a marked skill gain: the intervention was directly aligned with the measured skill. At the same time, systematic evidence also shows that training effects may not be uniform across all tests and populations; for example, balance-training evidence indicates positive effects on several basketball-related outcomes but not consistently across all assessment types (Wang, Chen, et al., 2025). Therefore, the present result should be interpreted as task-specific rather than as proof that the method improves all basketball skills. The implication is that teachers and coaches should design variable competitive tasks around the exact skill outcome they intend to improve.

The posttest superiority of the experimental group demonstrates that the combined use of collective competition and variable layup practice created a more effective instructional environment than traditional learning for the measured outcome. Theoretically, this finding can be understood through the interaction between movement variability, perceptual control, and

performance regulation. Basketball shooting accuracy depends not only on muscular execution but also on visual search, eye-movement control, release angle, posture consistency, and the ability to coordinate action under changing constraints. Studies using eye-movement analysis, shooting-angle comparison, posture recognition, convolutional-network shooting-action recognition, and immersive motion-capture training have shown that shooting performance involves observable movement patterns and perceptual-motor regulation (Fan et al., 2021; Gou et al., 2022; Liu et al., 2021; Nian et al., 2023; Özdalyan et al., 2022; Wei et al., 2022). The present study is consistent with this body of work because variable layup practice likely required students to repeatedly adjust movement organization and release control. Yet it differs from technology-based and biomechanical studies because it did not measure eye fixation, joint angles, release speed, or motion-capture variables; it measured only the final behavioral product of the skill through successful legal layup attempts. Competitive and contextual factors also matter. Evidence from varied game formats, training-load studies, and psychological-climate research indicates that basketball performance is affected by game interval structure, external load, athlete affect, psychological compatibility, and the broader practice environment (Brynzak et al., 2021; Figueira et al., 2022; García-Ceberino et al., 2022; López-Laval et al., 2022; Paulauskas et al., 2025; Ujaković et al., 2024; Wang, Mao, & Tang, 2025; Xiao et al., 2021). The present study shares the emphasis on context, but it cannot identify which mechanism competition, variability, repetition, motivation, or attention contributed most to the effect. This limitation is important because the intervention combined several elements simultaneously. Future research should separate these components experimentally, include retention and transfer tests, use raw-score reporting, and add psychological and biomechanical measures. Practically, the results support the use of short, structured, competitive, and variable layup tasks within basketball learning units, especially when instructional time is limited and the goal is measurable improvement in a specific scoring skill.

CONCLUSION

This study concludes that competitive collective variable training is more effective than traditional instruction in improving basketball layup shooting accuracy among fourth-year university students. The findings support the research hypothesis that students who practiced layup shooting through collective competition and variable movement conditions achieved greater improvement than students who followed the regular instructional method. This indicates that layup shooting accuracy can be developed more effectively when learners are exposed to practice situations that require repeated execution, movement adjustment, peer competition, and adaptation to different angles and distances. Scientifically, this study strengthens the view that basketball skill learning should not rely solely on fixed technical repetition. Layup shooting is an adaptive scoring skill that requires coordination among dribbling, legal stepping, body balance, movement timing, spatial adjustment, and accurate ball release. Therefore, learning conditions that combine variability and competitive engagement may provide a more representative environment for developing game-related shooting accuracy. Practically, the findings suggest that physical education teachers and basketball instructors can integrate short, structured, competitive, and variable layup tasks into instructional units to improve students' scoring skills within limited learning time. However, this study was limited to one university context, a relatively small sample, a four-week intervention period, and one basketball skill indicator. The study also did not examine long-term retention, psychological responses, biomechanical variables, tactical decision-making, or actual match

performance. Future studies should involve larger and more diverse samples, apply longer intervention periods, include retention and transfer tests, and compare the effect of this method on other basketball skills such as passing, dribbling, jump shooting, and defensive movement.

RECOMMENDATION

Based on the findings, competitive collective variable training is recommended as an alternative instructional strategy for improving basketball layup shooting accuracy in university-level physical education. Lecturers and basketball instructors should integrate short, structured, and competitive layup activities into regular learning units, especially by varying entry angles, distances, movement paths, and group-based scoring challenges. This approach can help students adapt their layup execution to more realistic game conditions rather than relying only on fixed technical repetition. In practical implementation, teachers should ensure that the training remains progressive, safe, and technically controlled. Students should first understand the correct layup sequence, including dribbling control, legal stepping, body balance, take-off rhythm, and ball release, before practicing under variable and competitive conditions. Small-group formats may be used to increase motivation, repetition, peer interaction, and learning engagement. Future research is recommended to involve larger and more diverse samples, longer intervention periods, and different educational or competitive levels. Further studies should also examine retention effects, transfer to actual match performance, and the influence of this method on other basketball skills such as dribbling, passing, jump shooting, and defensive movement. In addition, future research may include psychological, biomechanical, and tactical variables to clarify how competition, variability, motivation, and attention contribute to improved layup shooting accuracy. This will strengthen the evidence base for using competitive collective variable training in basketball instruction.

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