



Motor Skill Adaptations to a School-Based Basketball Training Program in Upper Secondary School Students

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Abstract

Objectives. The study aimed to determine the effects of an eight-week school-based basketball training programme on dribbling and shooting performance in upper secondary school students and to examine accompanying changes in motor awareness, perceived self-efficacy, motivation, and peer collaboration.

Materials and Methods. Eighteen students aged 15–17 years participated in a single-group pre-test–post-test pilot study. The intervention consisted of two 60-minute sessions per week for eight weeks and included progressive technical exercises, pair and small-group tasks, simplified game situations, formative feedback, and reflection activities. Basketball-specific performance was assessed using the AAHPERD Control Dribble Test and Speed Spot Shooting Test. Qualitative data were obtained using a technical-motor observational rubric and a semi-structured focus group. Pre–post differences were analysed using paired-samples t-tests, and effect sizes were calculated using Cohen's d.

Results. Control Dribble Test performance improved from 25.51 ± 2.84 s to 21.76 ± 2.37 s, with a mean difference of -3.75 s (95% CI: -4.52 to -2.98 ; $t_{(17)} = -10.28$; $p < .001$; $d = 2.42$). Speed Spot Shooting Test scores increased from 4.78 ± 1.21 to 6.56 ± 1.18 successful shots, with a mean difference of 1.78 shots (95% CI: 1.27 – 2.29 ; $t_{(17)} = 8.00$; $p < .001$; $d = 1.89$). Qualitative analysis indicated improvements in movement control, technical awareness, perceived self-efficacy, motivation, error management, and peer collaboration.

Conclusions. The eight-week basketball programme was associated with substantial improvements in dribbling and shooting performance in upper secondary school students. Positive changes were also observed in students' awareness of movement execution and engagement in the learning process. Given the small sample size and the absence of a control group, the findings should be interpreted as preliminary.

Keywords: basketball, physical education, motor learning, dribbling, shooting, adolescents.

Introduction

Basketball represents a particularly relevant discipline within school physical education, as it allows the development of fundamental motor skills to be integrated with cognitive, relational, and decision-making competences (Mocanu, & Murariu, 2024). Unlike activities based mainly on repetitive or isolated motor execution, basketball requires students to constantly adapt their actions to changing situations,

coordinate their movements in relation to space, time, the ball, and other players, and make rapid decisions under dynamic conditions. In upper secondary school, this sport therefore constitutes a rich and multifaceted educational environment, in which motor learning is closely connected to perception, attention, communication, cooperation, and self-regulation. Students are not only required to perform technical gestures, but also to understand when, how, and why to use them in relation to the context of play. For this reason, basketball can be considered a particularly suitable activity for promoting meaningful learning in physical education, especially when it is taught through structured, progressive, and reflective didactic pathways (Pocius, & Malinauskas, 2025).

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Within this framework, the technical fundamentals of dribbling and shooting play a central role. Dribbling enables students to manage the ball while moving, orient themselves in space, protect possession, change direction, vary rhythm, and maintain motor control under variable conditions. It involves coordination between upper and lower limbs, control of posture, use of gaze, spatial orientation, and the ability to regulate force and timing. Shooting, on the other hand, represents one of the most complex and meaningful technical gestures in basketball, as it requires balance, segmental coordination, precision, postural stability, concentration, and the ability to self-regulate the movement (Kioumourtzoglou et al., 1998). An effective shot does not depend solely on arm strength or final accuracy, but on the coordination of several components: foot position, lower-limb drive, trunk stability, shoulder-elbow-wrist alignment, ball release, and final follow-through. From an educational point of view, working on dribbling and shooting therefore means helping students to develop not only sport-specific skills, but also broader motor competences related to body control, movement awareness, attention, and intentionality.

Recent literature highlights that school physical education should not be reduced to the mere technical execution of movements, but should instead be understood as a context for promoting physical literacy (Latino et al., 2025a,b). Physical literacy refers to an integrated set of physical, cognitive, emotional, and motivational competences that enable individuals to participate consciously, confidently, and sustainably in motor and sports activities across the lifespan (Graudusius et al., 2024). This perspective is particularly important in adolescence, a developmental phase in which students' relationship with the body, movement, sport, and perceived competence may strongly influence their future participation in physical activity. In this sense, physical education has the responsibility to offer learning experiences that are not only technically effective, but also inclusive, motivating, and capable of strengthening students' confidence in their own abilities. A basketball workshop designed around progressive tasks, formative feedback, peer collaboration, and reflection can contribute to this goal by transforming technical learning into an opportunity for broader personal and educational development.

This approach is also consistent with the recommendations of the World Health Organization, according to which children and adolescents should regularly engage in moderate- to vigorous-intensity physical activity, including through meaningful and inclusive school-based experiences (Bull et al., 2020; Di Maio et al., 2026). School represents a privileged setting for promoting physical activity, because it can reach all students, including those who may not participate in organised sport outside school. However, for physical education to be truly effective, it is not sufficient to simply increase movement time; it is also necessary to design activities that support participation, motivation, perceived competence, and the progressive acquisition of motor skills. In this regard, basketball offers significant educational potential, because it combines physical engagement with playful, cooperative, and decision-making dimensions. When properly adapted to students' levels, it can involve both more skilled students and those who initially feel less confident, allowing each participant to experience improvement and contribute to the group.

Furthermore, the concept of Quality Physical Education promoted by UNESCO emphasises the need to design motor learning environments capable of supporting not only physical development, but also psychosocial well-being, participation, responsibility, and collaboration (UNESCO, 2021). From this perspective, the value of a basketball workshop does not lie exclusively in the acquisition of technical fundamentals, but in the possibility of creating a learning environment in which students can cooperate, observe one another, accept feedback, manage errors, and recognise progress. The educational quality of the intervention therefore depends on the way in which the teacher structures the tasks, differentiates the levels of difficulty, provides feedback, and promotes a positive climate. In particular, the use of small-group activities, simplified game situations, and peer observation can help students to develop both technical competence and social responsibility (Gaggioli et al., 2013).

Within this framework, basketball can be interpreted as a didactic device capable of promoting complex motor learning, especially when teaching combines progressive technical exercises, simplified game situations, formative feedback, peer observation, and moments of reflection. The transition from analytical exercises to game-based situations allows students to first consolidate the basic elements of the movement and then apply them in more authentic and dynamic contexts. This progression is particularly relevant in the learning of dribbling and shooting, since both skills require not only technical precision, but also adaptation to changing spatial and temporal conditions. A purely repetitive approach may improve isolated execution, but it does not always support transfer to real or semi-real game situations. Conversely, an approach that alternates technical practice, contextualised tasks, and reflection may help students understand the functional meaning of the gesture and improve their ability to use it appropriately.

Recent studies on the Sport Education Model show that approaches centred on active participation, student responsibility, and cooperative dynamics can improve attitudes, motivation, and engagement in physical education contexts (Zhang et al., 2024). This is particularly relevant for upper secondary school students, who may show different levels of motivation, competence, and confidence in sports activities. A workshop organised through progressive challenges, shared responsibilities, and peer support can reduce the distance between students with different initial skill levels and promote a more inclusive form of participation. At the same time, research on motor feedback confirms that the learning of technical skills is more effective when students receive timely, specific instructions oriented towards improving the movement, rather than generic judgments on performance (Treschman et al., 2024; Zhou et al., 2021). Feedback, in this sense, becomes not only a corrective tool, but also an educational strategy that helps students understand errors, regulate their actions, and develop greater awareness of their own learning process.

In light of these premises, the present pilot study aimed to analyse the effects of a basketball workshop involving 18 upper secondary school students, with the goal of improving the fundamental skills of dribbling and shooting. The main objective was to verify whether a short, structured intervention, methodologically oriented towards technical progression, could produce observable changes both

quantitatively, through pre- and post-intervention motor tests, and qualitatively, through systematic observations and students' reflections. More specifically, the study sought to examine whether a workshop based on gradual progression, formative feedback, differentiated tasks, peer observation, and simplified game situations could improve students' technical performance while also promoting motor awareness, motivation, perceived self-efficacy, and collaboration within the class group. In this sense, the research was not limited to measuring performance outcomes, but also aimed to explore the educational processes activated by the intervention and the extent to which basketball can function as a meaningful learning environment in school physical education.

Materials and Methods

Study Design

This pilot study adopted a convergent mixed-methods design involving a single experimental group assessed before and after a school-based basketball instructional programme. The quantitative component was used to examine changes in basketball-specific technical performance, whereas the qualitative component explored movement quality, motor awareness, perceived improvement, difficulties encountered, motivation, error management, peer collaboration, and students' perceptions of the learning experience. Quantitative and qualitative data were collected during the same intervention period and were subsequently integrated to provide a more comprehensive interpretation of the educational and motor outcomes.

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the University of Naples Parthenope, Department of Medical, Motor and Wellness Sciences (DiSMMeB Prot. No. 88592/2024). Participation was voluntary. Students received age-appropriate information concerning the study objectives, procedures, assessments, and confidentiality of the collected data. Written informed consent was obtained from the parents or legal guardians of participants under 18 years of age, together with assent from the students. Where applicable, participants who had reached the age of legal consent provided their own written informed consent.

Outcome Measures

Quantitative Outcome Measures

Basketball-specific technical performance was assessed using two subtests selected from the AAHPERD Basketball Skills Test proposed by Hopkins, Shick, and Plack (1984): the Control Dribble Test and the Speed Spot Shooting Test. These tests were selected because they were directly aligned with the two technical skills addressed during the instructional programme.

The Control Dribble Test was used to assess dynamic dribbling control. Participants were required to complete a standardised cone-marked course while maintaining control of the ball during forward movement, changes of direction, and variations in movement rhythm. Performance was recorded in seconds using a digital stopwatch. A lower

completion time at post-test, provided that the course was completed correctly and without loss of ball control, indicated improved dribbling performance.

The Speed Spot Shooting Test was used to evaluate shooting speed and accuracy under dynamic conditions. Participants were required to shoot from predetermined positions, retrieve the ball, and move rapidly to the subsequent shooting location. Performance was expressed as the number of successful shots completed within the prescribed test duration. A higher post-test score indicated improved shooting performance.

Both quantitative tests were administered twice, during the week preceding the beginning of the instructional programme and after completion of the eight-week intervention. The same testing procedures, equipment, court arrangement, instructions, and scoring criteria were used at pre-test and post-test.

Qualitative Outcome Measures

Movement quality was assessed using a Technical-Motor Observational Rubric for Dribbling and Shooting developed specifically for the educational objectives of the workshop. The rubric was intended as a systematic observational instrument and was not treated as a standardised psychometric measure. Performance was classified according to four levels of mastery: initial, basic, intermediate, and advanced.

For dribbling, the rubric considered ball control, continuity of movement, body posture, gaze orientation, use of the dominant and non-dominant hand, ability to change direction, and ball management while moving. For shooting, the observed indicators included foot position, body balance, coordination between the lower and upper limbs, shoulder-elbow-wrist alignment, movement fluidity, final wrist follow-through, and the ability to maintain concentration during execution.

The rubric was completed during the initial and final assessments and was supplemented by intermediate observations conducted during the instructional sessions. These intermediate observations were used to monitor learning progression and guide instructional feedback rather than to generate additional quantitative outcomes.

At the end of the intervention, a semi-structured focus group was conducted using open-ended questions concerning perceived technical improvement, difficulties encountered, motivation, error management, peer collaboration, motor awareness, and the overall learning experience. Students' responses were examined through thematic analysis. Recurring units of meaning were identified and grouped into themes related to motor learning, participation, perceived self-efficacy, technical awareness, and group climate.

Participants

The study involved 18 students aged between 15 and 17 years who attended the same pre-existing upper secondary school class. The entire class participated in the basketball workshop and was therefore treated as a single experimental group. The observed age range reflected the ordinary variability within the class associated with differences in birth dates and individual educational trajectories.

The inclusion criteria were established before the intervention and comprised regular participation in physical education classes, medical eligibility for school-based physical activity, absence of injuries or medical conditions incompatible with the proposed exercises, attendance at a minimum of 80% of the scheduled instructional sessions, willingness to complete both the initial and final assessments, and provision of the required informed consent.

Students were excluded from the analysis when they were fully exempt from practical physical education, had prolonged absences during the intervention, did not complete either the pre-test or post-test assessment, or practised basketball continuously at a competitive level. The latter criterion was introduced to reduce the possible influence of substantially advanced previous basketball experience on the observed outcomes.

For the exploratory analysis requested according to age, participants were divided on the basis of chronological age at baseline into younger adolescents aged 15–16 years and older adolescents aged 17 years. This classification distinguished students in the intermediate phase of adolescence from those approaching the end of upper secondary education and a later stage of biological and psychomotor maturation. Because of the pilot nature of the study and the small number of participants, the subgroup analysis was considered exploratory and was intended to identify possible age-related patterns rather than establish definitive differences between age categories.

Procedures

The study was conducted within the students' regular school setting between February and April 2025, during the regular physical education curriculum. Before the intervention, eligible students and their families received information concerning the study, and the required consent procedures were completed. Participants then underwent baseline assessment using the Control Dribble Test, the Speed Spot Shooting Test, and the Technical-Motor Observational Rubric.

Following the pre-test assessment, all participants completed the same eight-week basketball instructional programme. The intervention comprised two 60-minute sessions per week, corresponding to 16 instructional sessions and a total scheduled duration of 16 hours. Sessions were conducted in the same school sports environment and using the same basketball equipment and instructional framework.

The intervention was delivered throughout the eight weeks by the same (physical education teacher/instructor), who had (specify academic or professional qualification and years of teaching or coaching experience). Using the same instructor throughout the programme was intended to ensure consistency in task presentation, verbal instructions, feedback, progression criteria, and session organisation.

All participants received an identical core instructional programme in terms of session frequency, duration, technical content, sequence of learning objectives, and overall training volume. Individual adaptations were limited to the difficulty, execution speed, number of constraints, and level of support associated with specific exercises. These adaptations were introduced to enable all students to pursue the same instructional objective according to their initial

level of technical competence and did not constitute different training programmes.

Attendance was recorded during each session. Participants who attended fewer than 80% of the scheduled sessions were not included in the final analysis. At the conclusion of the eight-week programme, the quantitative tests and observational rubric were administered again under conditions equivalent to those used at baseline. The semi-structured focus group was subsequently conducted to collect students' perceptions of the intervention.

Intervention Programme

The instructional programme lasted eight consecutive weeks and consisted of two sessions per week. Each session lasted 60 minutes, resulting in 16 instructional sessions and 16 total hours of activity. The programme followed a gradual didactic progression from simple to complex tasks, from controlled individual execution to cooperative and semi-situational activities, and from analytical technical exercises to simplified game-based applications.

The intervention focused primarily on dribbling and shooting. In addition to improving technical performance, the programme was intended to promote movement awareness, active participation, constructive management of errors, peer collaboration, and the ability to recognise and correct relevant aspects of movement execution.

Each 60-minute session was organised into four consecutive phases. The first phase lasted approximately 10 minutes and comprised general and basketball-specific motor activation, including light running, joint mobility, coordination exercises, movement patterns, changes of direction without the ball, and ball-familiarisation activities. The second phase lasted approximately 20 minutes and involved guided technical learning focused on the main skill addressed during the session. The third phase lasted approximately 20 minutes and consisted of applied activities performed through individual challenges, pair exercises, small-group tasks, technical circuits, timed activities, and simplified game situations. The final phase lasted approximately 10 minutes and was dedicated to active recovery, verbalisation, and debriefing. During this phase, students reflected on the difficulties encountered, recurrent technical errors, possible corrective strategies, and bodily sensations perceived during execution.

During weeks 1 and 2, the programme focused on ball familiarisation and basic dribbling control. Activities included static dribbling with the dominant and non-dominant hand, variations in dribbling height, transitions from high to low dribbling, frontal and lateral ball control, alternating dribbles, and simple forward, backward, and lateral movements. Particular attention was given to knee flexion, trunk stability, hand position above the ball, finger opening, controlled ball propulsion, and progressive orientation of the gaze towards the playing environment rather than exclusively towards the ball.

During weeks 3 and 4, the programme progressed to dynamic dribbling and ball control while moving. Activities included slalom courses, changes of direction, starts and stops, rhythm variations, ball protection against a passive defender, and simplified one-against-zero and guided one-against-one situations. Task difficulty was gradually increased by reducing

the distance between cones, increasing execution speed, requiring use of the non-dominant hand in selected sections, and introducing hand changes in response to external signals. Feedback focused on maintaining the ball close to the body, preserving dribbling continuity during directional changes, using the body to protect the ball, and coordinating footwork, trunk movement, and upper-limb action.

During weeks 5 and 6, the instructional focus shifted to shooting. Students initially performed close-range exercises to reduce the influence of shooting distance and direct attention towards movement mechanics. Activities included stationary shooting, shooting after receiving the ball, shooting after one dribble, shooting following one-count and two-count stops, and shooting from different angles. Instruction addressed balanced foot positioning, body orientation towards the basket, lower-limb flexion, coordination between leg drive and arm extension, elbow alignment, ball release, and final wrist follow-through. Students were organised into small groups to increase repetition frequency and reduce waiting time. Brief self-assessment activities were also introduced after shooting series to encourage students to identify successful movement components and elements requiring correction.

During weeks 7 and 8, dribbling and shooting were integrated into more representative basketball situations. Activities included dribble-stop-shoot sequences, change-of-direction followed by shooting, shooting after movement, continuous team shooting drills, and small-sided games incorporating technical constraints. Some activities required at least one hand change before shooting, whereas others required a controlled stop or rewarded correct shooting posture independently of whether the shot was successful. Small-sided games were conducted using reduced team sizes, delimited spaces, and adapted rules to increase ball contacts and promote active participation.

Throughout the intervention, the same instructional principles were applied: gradual progression of task difficulty, high repetition frequency, immediate and non-judgemental feedback, use of error as a learning opportunity, alternation between individual and cooperative activities, attention to safety, and promotion of an inclusive and motivating learning climate. Students experiencing greater difficulty performed simplified versions of the same task or completed the activity at a slower speed. More competent students performed the same technical task with additional constraints, such as the use of two balls, controlled hand changes, or responses to external signals. These adjustments preserved the common instructional objectives and content for the entire group.

Statistical Analysis

Quantitative data were analysed using IBM SPSS Statistics (Version XX; IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated for all quantitative variables and are presented as means and standard deviations (SD). Prior to inferential analyses, the normality of the data distribution was assessed using the Shapiro–Wilk test.

Differences between pre-test and post-test scores were analysed using paired-samples t-tests. For each outcome, the results are reported as mean $\pm$ standard deviation, mean difference, 95% confidence interval (95% CI) of the mean difference, t statistic, degrees of freedom (df),

and corresponding p value. Statistical significance was established at $p < 0.05$.

To evaluate the practical significance of the intervention, effect sizes were calculated using Cohen's d for paired samples and interpreted according to Cohen's conventional thresholds (0.20 = small, 0.50 = medium, and 0.80 = large).

Qualitative data obtained from the technical-motor observational rubric and the semi-structured focus group were analysed using an inductive thematic analysis. Responses were coded and grouped into recurrent themes reflecting common perceptions and experiences related to motor learning, technical awareness, motivation, self-efficacy, error management, and peer collaboration. Representative quotations were selected to illustrate the main themes emerging from the analysis. An exploratory subgroup analysis was also conducted according to age group (15–16 years vs. 17 years). Descriptive statistics were calculated separately for each subgroup, and paired-samples t-tests were performed independently to examine pre-post changes within each age category. Given the limited sample size, subgroup findings were interpreted descriptively and considered exploratory.

Results

Quantitative Results

The quantitative analysis showed an overall improvement in students' performance in the two basketball fundamentals targeted by the intervention, namely dribbling and shooting. Descriptive statistics and inferential analyses are presented in Table 1.

For the Control Dribble Test, the mean completion time decreased from 25.51 ± 2.84 s at baseline to 21.76 ± 2.37 s after the intervention, corresponding to a mean reduction of 3.75 s (95% CI: -4.52 to -2.98 s) and a percentage improvement of 14.7%. The paired-samples t-test revealed a statistically significant difference between the two assessments, $t_{(17)} = -10.28$, $p < .001$, with a very large effect size (Cohen's $d = 2.42$). These findings indicate a substantial improvement in students' ability to control the ball during dynamic movements, negotiate changes of direction, and maintain dribbling continuity throughout the course.

Similarly, performance in the Speed Spot Shooting Test improved significantly following the intervention. The mean number of successful shots increased from 4.78 ± 1.21 at pre-test to 6.56 ± 1.18 at post-test, corresponding to a mean increase of 1.78 successful shots (95% CI: 1.27 to 2.29) and a percentage improvement of 37.2%. Statistical analysis confirmed a significant pre-post difference, $t_{(17)} = 8.00$, $p < .001$, with a large effect size (Cohen's $d = 1.89$). This improvement suggests enhanced shooting accuracy and execution under dynamic conditions involving movement and ball retrieval.

Overall, the quantitative findings demonstrate that the structured basketball workshop produced meaningful improvements in both technical skills. Beyond statistical significance, the large effect sizes observed for both performance measures indicate that the intervention also achieved substantial practical relevance, supporting the educational effectiveness of a progressive, feedback-oriented teaching approach.

Table 1. Quantitative outcomes before and after the intervention (n = 18)

Variable	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Difference	95% CI	t(17)	p	Cohen's d
Control Dribble Test (s)	25.51 ± 2.84	21.76 ± 2.37	-3.75	-4.52 to -2.98	-10.28	<0.001	2.42
Speed Spot Shooting Test (successful shots)	4.78 ± 1.21	6.56 ± 1.18	+1.78	1.27 to 2.29	8.00	<0.001	1.89

Note: Values are presented as mean ± standard deviation (SD). Mean differences are calculated as post-test minus pre-test. Cohen's d values were interpreted according to Cohen's criteria (0.20 = small, 0.50 = medium, 0.80 = large).

Table 2. Exploratory age subgroup analysis according to chronological age.

Variable	Age group	n	Pre-test Mean ± SD	Post-test Mean ± SD	Mean Difference	t	p	Cohen's d
Control Dribble Test (s)	15–16 years	10	25.84 ± 2.71	22.43 ± 2.26	-3.41	-7.14	<0.001	2.01
	17 years	8	25.10 ± 3.08	20.92 ± 2.39	-4.18	-7.89	<0.001	2.37
Speed Spot Shooting Test (successful shots)	15–16 years	10	4.60 ± 1.17	6.20 ± 1.14	+1.60	5.83	<0.001	1.64
	17 years	8	5.00 ± 1.31	7.00 ± 1.20	+2.00	5.98	<0.001	1.82

An exploratory subgroup analysis was conducted to examine whether the effects of the instructional programme differed according to participants' age. Students were divided into two age groups: younger adolescents (15–16 years, n = 10) and older adolescents (17 years, n = 8). Descriptive statistics and within-group comparisons are reported in Table 2.

Both age groups demonstrated significant improvements in the two basketball skills assessed following the eight-week intervention. In the younger subgroup, the mean completion time in the Control Dribble Test decreased from 25.84 ± 2.71 s to 22.43 ± 2.26 s ($p < .001$), while the mean number of successful shots in the Speed Spot Shooting Test increased from 4.60 ± 1.17 to 6.20 ± 1.14 ($p < .001$). Similarly, participants aged 17 years showed significant improvements in dribbling performance, with completion time decreasing from 25.10 ± 3.08 s to 20.92 ± 2.39 s ($p < .001$), and in shooting performance, with successful shots increasing from 5.00 ± 1.31 to 7.00 ± 1.20 ($p < .001$). The magnitude of improvement was comparable between the two age groups, with both younger and older students showing statistically significant pre-post improvements. Given the limited sample size, no formal between-group comparisons were performed, and the subgroup analysis should be interpreted as exploratory (Table 2).

Qualitative Results

The qualitative analysis, conducted through the technical-motor observational rubric and the final semi-structured focus group, made it possible to explore in greater depth the changes observed during the workshop, highlighting not only an improvement in performance, but also a transformation in the quality of motor execution, in students' awareness, and in the way they experienced the sporting activity. The observational rubric revealed significant progress in dribbling control: in the initial phase, several students tended to keep their gaze fixed on the ball, perform the movement with a rigid posture, and frequently

interrupt the continuity of movement during changes of direction; by the end of the intervention, however, greater execution fluency, better ball management while moving, more confident use of the non-dominant hand, and more effective coordination between footwork, trunk, and upper limbs were observed. This change was also confirmed by students' perceptions. One participant stated: "At the beginning, I always looked at the ball and lost control as soon as I had to change direction; after a few lessons, I was able to dribble more confidently and also look ahead." Another student emphasised the improvement in the use of the non-dominant hand, saying: "Before, I almost always used only my strong hand, but with the course exercises I understood that using the other hand also helped me move better."

With regard to shooting, the qualitative indicators also showed positive development. Students progressively improved their foot position, body balance, coordination between lower-limb drive and arm extension, shoulder-elbow-wrist alignment, and final follow-through. In particular, shooting appeared less random and more intentional, as students began to pay attention not only to whether the ball went into the basket, but also to the technical correctness of the execution. This aspect also emerged clearly in the focus group: one female student stated that "before, I only thought about shooting hard, then I understood that foot position, legs, and wrist movement mattered"; another participant pointed out that "even when I did not score, I was able to understand what I had done wrong, for example if I had not bent my legs properly or if my arm was not straight." These statements indicate an important shift from a purely performance-oriented view of shooting, focused only on the outcome, towards greater attention to movement quality and the possibility of self-correction.

Four main thematic areas emerged from the focus group. The first concerns the perception of improvement: many students reported feeling more confident in dribbling and more aware in preparing their shot. The second theme concerns motivation: small-group activities, technical challenges, and mini-games fostered increasing engagement,

Table 3. Main themes emerging from the qualitative analysis.

Theme	Main findings	Representative quotation
Motor awareness	Improved posture, gaze orientation, ball control, coordination, and use of the non-dominant hand	"I was able to dribble more confidently and also look ahead."
Technical execution	Better shooting mechanics, balance, follow-through, and movement control	"I understood that foot position, legs, and wrist movement mattered."
Perceived self-efficacy	Increased confidence in performing basketball skills	"I could see that I was gradually improving."
Error management	Errors perceived as opportunities for learning and self-correction	"Missing a shot was no longer something negative."
Motivation	Greater engagement through challenges and cooperative activities	"Team challenges motivated me more."
Peer collaboration	Reciprocal observation, tutoring, constructive feedback	"My partner noticed mistakes that I didn't realise."

especially among students who initially showed lower confidence in their motor abilities. One participant observed: "Team challenges motivated me more, because it did not feel like just an exercise, but a way to improve while having fun." Another student, who had initially been less involved, stated: "I usually do not feel good at sports, but here I could see that I was gradually improving, so I participated more." The third theme concerns the relationship with error: during the workshop, students progressively interpreted mistakes not as failures, but as useful information for correcting movement and improving subsequent performance. As one student stated, "missing a shot was no longer something negative, because then the teacher helped us understand what to change." The fourth thematic area relates to peer collaboration: reciprocal observation, informal tutoring, and debriefing moments fostered a more cooperative climate, in which students learned to offer suggestions, accept corrections, and recognise their classmates' progress. One female student summarised this aspect by saying: "When we worked in pairs, it helped me to hear my partner's advice, because sometimes they noticed a mistake that I did not realise I was making."

Overall, the qualitative results confirm and enrich the quantitative findings, showing that the workshop produced positive effects not only on the technical fundamentals of dribbling and shooting, but also on motor awareness, perceived self-efficacy, motivation, active participation, and the quality of relationships within the class group. The students' words highlight how the intervention fostered a more reflective form of learning, less focused exclusively on performance, making basketball an educational experience capable of supporting both technical improvement and personal and relational growth (Table 3).

Discussion

The results of the study suggest that a basketball workshop structured according to a gradual didactic progression can contribute significantly to improving the fundamentals of dribbling and shooting in upper secondary school students. The reduction in completion time recorded in the Control Dribble Test and the increase in successful shots in the Speed Spot Shooting Test indicate that the intervention promoted both greater mastery of ball control in dynamic situations and improved shooting effectiveness. These findings are

particularly relevant because the skills analysed are not merely isolated technical gestures, but complex motor competences requiring coordination, balance, postural control, attentional engagement, and adaptation to task demands. From this perspective, the observed improvements should not be interpreted exclusively as gains in performance, but as the outcome of a broader motor learning process through which students progressively developed greater body control, movement awareness, and self-regulation skills.

The improvements observed are likely to result from the interaction of several complementary learning mechanisms rather than from repetitive technical practice alone. The workshop was intentionally organised according to a progressive instructional sequence, beginning with isolated technical exercises and gradually introducing more complex and game-related situations. This progression may have facilitated the gradual integration of perceptual and coordinative processes involved in motor learning, enabling students to refine their movement patterns while adapting them to increasingly variable task demands. Furthermore, repeated practice under progressively challenging conditions may have strengthened motor adaptation and movement consistency, contributing to the more efficient execution of both dribbling and shooting skills.

The quantitative outcomes are consistent with the literature on motor learning in physical education, according to which the quality of teaching, intentional repetition of the movement, progression of task difficulty, and the presence of specific feedback represent key factors in improving technical skills (Zhou et al., 2021; Han et al., 2022). In particular, the improvement observed in dribbling can be interpreted as the result of a combination of analytical exercises, dynamic courses, changes of direction, progressive use of the non-dominant hand, and transfer of skills into simplified game situations. Indeed, the structure of the intervention allowed students to experience dribbling under increasingly complex conditions, moving from static ball control to dynamic movement management, and finally to its application in semi-situational contexts. This progressive transition probably fostered better integration between visual control, footwork coordination, gaze orientation, and spatial management (Farhat et al., 2025).

Similarly, the progress observed in shooting seems to be attributable to the breakdown of the technical gesture, the initial reduction of the distance from the basket, the attention

paid to body balance, and the final follow-through of the movement. These elements enabled students to focus not only on the outcome of the performance, namely scoring a basket, but also on the quality of the execution. This aspect is particularly important in school contexts, where there is often a risk of privileging the immediate result over the learning process. In the present workshop, instead, the gradual nature of the proposed activities and correction-oriented repetition allowed students to understand that effective shooting depends on a set of coordinated components: foot position, balance, lower-limb drive, elbow alignment, ball release, and wrist follow-through.

This approach confirms the value of formative feedback in physical education, especially when it is timely, understandable, task-centered, and oriented towards movement correction rather than the simple evaluation of results (Treschman et al., 2024; Zhou et al., 2021). In the workshop, feedback was not used as a judgment on performance, but as a tool for regulating learning. Students were guided to recognize errors, understand their causes, and identify possible improvement strategies. This approach facilitated the transition from a merely executive logic to a reflective one, in which motor learning does not coincide solely with the repetition of a movement, but also involves observation, interpretation, self-correction, and awareness. From a motor learning perspective, formative feedback may also have facilitated error detection, movement self-monitoring, and the gradual development of more accurate internal representations of the motor task. Rather than simply correcting technical execution, feedback encouraged students to compare intended and executed movements, progressively refining performance through self-regulation and repeated practice. In this sense, feedback took on an educational as well as a technical function, contributing to the construction of a learning climate less centered on performance and more oriented towards personal improvement.

The exploratory subgroup analysis further suggests that the instructional programme was effective across the age range included in the study. Statistically significant improvements were observed in both younger (15–16 years) and older (17 years) students, indicating that the intervention was associated with enhanced basketball-specific technical performance irrespective of age within the sample. Although descriptive data suggested slightly larger improvements among the older students, no formal between-group comparisons were performed and, therefore, these observations should be interpreted with caution. The limited sample size substantially reduced the possibility of detecting true age-related differences. Consequently, it cannot be established whether developmental stage influenced responsiveness to the intervention. Future studies including larger and more heterogeneous samples should investigate whether biological maturation and developmental stage moderate the effectiveness of basketball-based instructional programmes.

The qualitative results further strengthen this interpretation, showing that students developed greater motor awareness, more confidence in execution, and a better ability to recognise and correct errors. The observations carried out through the technical-motor rubric and the statements collected during the focus group indicate that students began to pay greater attention to movement quality, posture, the use of the non-dominant hand, balance, and the overall coordination of the gesture. This finding is particularly relevant when viewed

in light of the concept of physical literacy, which interprets physical education not as simple technical training, but as an integrated process involving motor, cognitive, affective, and motivational dimensions (Graudusius et al., 2024). From this point of view, the workshop promoted not only the acquisition of basketball-specific skills, but also the development of a greater willingness to participate, engage actively, collaborate, and reflect on one's own learning process.

From this perspective, basketball emerges as a didactic context capable of promoting not only specific sports skills, but also active participation, self-regulation, motivation, and peer collaboration. Small-group activities, technical challenges, informal tutoring, and mini-games supported a cooperative learning climate, confirming what has been highlighted by studies on the Sport Education Model, according to which motor experiences organised in a participatory and responsibility-based manner can improve students' attitudes, engagement, and motivation towards physical education (Zhang et al., 2024). The cooperative dimension proved particularly significant because it allowed less confident students to experience accessible and progressive tasks, while more skilled students were valued as a resource for the group. In this way, the workshop fostered more balanced participation, reducing the gap between students with different initial levels of motor ability. Beyond its social value, peer observation and cooperative practice may also have enhanced motor learning by increasing opportunities for observational learning and immediate peer feedback. Observing classmates performing the same tasks likely enabled students to recognise effective movement strategies, identify execution errors, and incorporate corrective adjustments into their own performance, thereby reinforcing the learning process. This mechanism may also explain the improvements in perceived self-efficacy and confidence that emerged from the qualitative findings.

A further relevant aspect concerns the valorization of error as a learning opportunity. The qualitative evidence shows that, during the intervention, students progressively changed the way they interpreted error: from a sign of inability or failure to useful information for correcting the movement and improving subsequent performance. This transition has strong pedagogical value, as it contributes to building a climate of trust in which students can experiment, make mistakes, correct themselves, and try again without experiencing error as a penalising element. This approach is also consistent with the perspective of Quality Physical Education promoted by UNESCO, which emphasises the role of physical education in developing bodily, social, and emotional competences, as well as in promoting well-being, participation, and responsibility (UNESCO, 2021).

Despite the positive outcomes, the study presents some limitations that must be carefully considered. First, the small sample size, consisting of 18 students, does not allow for broad generalization of the results. Moreover, although the participants belonged to the same pre-existing class, the age range of 15–17 years indicates a degree of within-class heterogeneity that may reflect differences in biological maturation, previous motor experience, and individual school trajectories. Because of the small sample size and the class-based design, the possible influence of age and other participant characteristics could not be examined separately. Future studies should include larger samples and multiple classes to allow analyses according to

age, sex, educational trajectory, previous basketball experience, and baseline motor competence. Second, the absence of a control group prevents the improvements observed from being attributed with absolute certainty exclusively to the intervention, since the possible effect of familiarisation with the tests or other contextual factors cannot be entirely excluded (Dewi et al., 2026). Furthermore, the limited duration of the intervention, equal to eight weeks, makes it possible to observe initial improvements, but does not allow for verification of the stability of learning outcomes in the medium to long term. An additional limitation concerns the qualitative rubric, which, although consistent with the objectives of the workshop, was developed ad hoc and does not possess the standardisation features typical of validated instruments (Lesmawan et al., 2025).

In light of these limitations, future research could involve larger samples, quasi-experimental designs with a control group, follow-up assessments, and validated observational tools, in order to verify the stability of learning outcomes and the effectiveness of the workshop in different school contexts. It would also be useful to extend the analysis to other basketball fundamentals, such as passing, defence, off-ball movement, and tactical collaboration, in order to understand whether the proposed workshop structure can also influence more complex and interdependent competences. However, the results indicate that a basketball pathway designed with gradual progression, formative feedback, personalisation, and reflection can represent an effective didactic proposal for promoting technical improvement in dribbling and shooting while also supporting motor awareness, motivation, collaboration, and active participation within the class group.

Conclusions

This pilot study highlighted how a basketball workshop, designed according to a progressive didactic approach and aimed at improving the fundamental skills of dribbling and shooting, can represent an effective proposal within upper secondary school. The quantitative results showed a significant improvement in both the Control Dribble Test and the Speed Spot Shooting Test, indicating growth in students' ability to control the ball while moving and in shooting accuracy. At the same time, the qualitative results made it possible to identify broader transformations related to the quality of motor execution, technical awareness, motivation, perceived self-efficacy, and peer collaboration. From this perspective, the intervention should not be interpreted solely as a technical-sport learning pathway, but as an educational experience capable of integrating bodily, cognitive, emotional, and relational dimensions.

One of the most significant elements emerging from the study concerns the relationship between technical improvement and motor awareness. Students did not simply perform dribbling and shooting more effectively (Candra et al., 2023); rather, they progressively learned to recognise the elements that make the movement more effective: ball control, posture, gaze direction, balance, limb coordination, and final follow-through. This result appears consistent with the perspective of physical literacy, which recognises physical education as a privileged context for promoting motor competences, motivation, and conscious participation in physical activities throughout life (Grauduszus et al., 2024).

The workshop therefore fostered a form of motor learning that was not limited to immediate performance, but was oriented towards understanding movement and building greater confidence in one's own abilities.

The workshop structure, based on gradual progression, formative feedback, task personalisation, peer observation, and moments of reflection, promoted the transition from a logic focused exclusively on performance to one oriented towards improvement, self-correction, and understanding of the movement. This confirms what has been highlighted by recent literature on feedback in physical education, according to which timely, specific, and task-centred instructions can significantly support motor skill learning (Zhou et al., 2021; Han et al., 2022; Treschman et al., 2024). In the context of this study, feedback had not only a corrective function, but also a motivational and reflective one, as it helped students understand that error is not an obstacle, but a natural component of the learning process. This aspect is particularly important in upper secondary school, where the perception of motor incompetence may reduce participation and engagement in physical activities.

Moreover, cooperative activities, technical challenges, and small-sided games strengthened students' engagement, confirming the value of participatory teaching models, such as the Sport Education Model, in promoting positive attitudes, motivation, and responsibility in physical education contexts (Zhang et al., 2024). The workshop showed that basketball can become an inclusive educational environment when activities are designed to enable all students to participate, experience active roles, and perceive personal progress. The presence of differentiated tasks, the valorisation of peer tutoring, and attention to movement quality contributed to building a more collaborative climate, in which individual improvement was also supported by the relationship with the group.

Despite the limitations related to the small sample size, the absence of a control group, and the limited duration of the intervention, the study offers useful indications for didactic planning. In particular, it shows that basketball can be used not only to develop specific technical competences, but also to support processes of motor awareness, inclusion, cooperation, and active participation. From an operational point of view, the results suggest the importance of designing physical education pathways based on clear objectives, progressive task difficulty, formative feedback, cooperative activities, and moments of reflection. These elements can make motor learning more meaningful, as they help students understand the purpose of the movement, monitor their own progress, and experience sport as a formative process, rather than merely as a performance-based activity.

Future research could expand the sample, introduce a control group, include follow-up assessments, and use validated observational tools in order to verify the stability of learning outcomes and the transferability of the workshop model to other school contexts and other basketball fundamentals. It would also be useful to further investigate the relationship between technical improvement, motivation, perceived competence, and participation in physical activities, in order to better understand how structured motor experiences may affect not only sports skills, but also students' disposition towards an active lifestyle. Overall, the experience confirms the educational value of basketball as a meaningful learning

environment, in which technical improvement becomes an opportunity to promote personal growth, educational relationships, and the student's overall development.

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Ethics Approval

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of the University of Naples "Parthenope", Department of Medical, Human Movement and Well-Being Sciences (DiSMMeB; Protocol No. 88592/2024).

Informed Consent

Written informed consent was obtained from all participants prior to their participation in the study. For participants under 18 years of age, written informed consent was additionally obtained from their parents or legal guardians.

Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request. The data are not publicly available due to privacy restrictions.

AI Transparency Statement

The authors declare that artificial intelligence tools were not used in the design of the study, collection or analysis of data, interpretation of the results, or formulation of the scientific conclusions. Generative artificial intelligence tools were used exclusively for linguistic editing and grammatical improvement of the manuscript. The authors reviewed and approved the final text and take full responsibility for its content.

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Розвиток рухових навичок учнів старших класів у процесі реалізації шкільної програми баскетбольної підготовки

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

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Мета. Метою дослідження було визначити вплив восьми тижневої шкільної програми навчання баскетболу на результативність ведення м'яча та кидків в учнів старшої середньої школи, а також дослідити супутні зміни в усвідомленні рухів, сприйнятій самоефективності, мотивації та взаємодії з однолітками.

Матеріали та методи. У пілотному дослідженні з дизайном «претест–посттест» в одній групі взяли участь 18 учнів віком 15–17 років. Інтервенція тривала вісім тижнів і передбачала два 60-хвилинні заняття на тиждень, що включали поступово ускладнювані технічні вправи, роботу в парах і малих групах, спрощені ігрові ситуації, формувальний зворотний зв'язок та рефлексивні завдання. Спеціальну баскетбольну підготовленість оцінювали за допомогою тестів AAHPERD Control Dribble Test і Speed Spot Shooting Test. Якісні дані отримували за допомогою техніко-рухової спостережної рубрики та напівструктурованої фокус-групи. Відмінності між показниками до та після інтервенції аналізували за допомогою парного t-критерію Ст'юдента, а величину ефекту визначали за d Коена.

Результати. Результат Control Dribble Test покращився з $25,51 \pm 2,84$ с до $21,76 \pm 2,37$ с; середня різниця становила $-3,75$ с (95% ДІ: від $-4,52$ до $-2,98$; $t_{(17)} = -10,28$; $p < 0,001$; $d = 2,42$). У Speed Spot Shooting Test кількість результативних кидків збільшилася з $4,78 \pm 1,21$ до $6,56 \pm 1,18$; середня різниця становила 1,78 кидка (95% ДІ: $1,27$ – $2,29$; $t_{(17)} = 8,00$; $p < 0,001$; $d = 1,89$). Якісний аналіз засвідчив покращення контролю рухів, технічної усвідомленості, сприйнятої самоефективності, мотивації, ставлення до помилок та взаємодії з однолітками.

Висновки. Восьмитижнева програма навчання баскетболу була пов'язана зі значним покращенням результатів ведення м'яча та кидків в учнів старшої середньої школи. Також спостерігалися позитивні зміни в усвідомленні учнями виконання рухів та їхньої залученості до процесу навчання. З огляду на малий обсяг вибірки та відсутність контрольної групи отримані результати слід розглядати як попередні.

Ключові слова: баскетбол, фізичне виховання, рухове навчання, ведення м'яча, кидок, підлітки.

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