Sport Science Training and Research - STAR

Research article

Effects of a modified games program based on the Constraints-Led approach on shooting accuracy in basketball in 10-year-old children

Efectos de un programa de juegos modificados basado en el enfoque Constraints-Led sobre la precisión del lanzamiento en baloncesto en niños de 10 años

[1]Richard Baldomero Corozo-Palma
University of Guayaquil
https://orcid.org/0000-0002-2197-4766
richard.corozop@ug.edu.ec
Ecuador, Guayaquil

[1]Faculty member of the Faculty of Physical Activity Sciences, University of Guayaquil. Master in Educational Administration, César Vallejo University (Peru). Bachelor's Degree in Physical Education, University of Guayaquil (Ecuador).

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Abstract

Introduction: The Constraints-Led initiative has become a relevant approach in sports initiation, as it promotes technical learning through modified games that integrate perception, action, and decision-making in contexts representative of the game.

Objective: To evaluate the effects of a modified games program based on the Constraints-Led approach on shooting accuracy in basketball for 10-year-old children at the Municipal School of Salitre.

Methodology: The study had a quantitative approach, a pre-experimental design, and a single group with pretest-posttest. Thirty 10-year-old children were part of it. The AAHPERD Basketball Shooting Test and the Basketball Field Goal Speed Spot Shooting Test were used to assess shooting accuracy. Normality was checked using the Shapiro-Wilk test and the differences between measurements were studied with the Wilcoxon signed-rank test.

Results: In the AAHPERD Basketball Shooting Test, the average increased from 3.77 ± 1.07 to 6.77 ± 1.07 successful shots (79.6%). In the Basketball Field Goal Speed Spot Shooting Test, the average increased from 4.77 ± 1.07 to 7.77 ± 1.07 baskets (62.9%). The two instruments showed very significant differences ($Z = -4.81$; $p < .001$).

Discussion: Adapted games facilitate technical learning by integrating motor, perceptual, and cognitive demands in real game situations.

Conclusions: The program significantly improved shooting accuracy, making it an effective strategy for teaching basketball at an early age.

Keywords: Motor learning; basketball; physical education; sports training; sports performance.

Resumen

Introducción: La iniciativa Constraints-Led se ha convertido en un enfoque relevante en la iniciación deportiva, ya que favorece el aprendizaje técnico a través de juegos modificados que integran la percepción, la acción y la toma de decisiones en contextos representativos del juego.

Objetivo: Evaluar los efectos de un programa de juegos modificados basado en el enfoque Constraints-Led sobre la precisión del lanzamiento en baloncesto en niños de 10 años de la Escuela Municipal de Salitre.

Metodología: El estudio tuvo enfoque cuantitativo, diseño preexperimental y de grupo único con pretest-postest. Fueron parte de ello 30 niños de 10 años. El AAHPERD Basketball Shooting Test y el Basketball Field Goal Speed Spot Shooting Test se usaron para evaluar la precisión de lanzamiento. La normalidad fue comprobada mediante la prueba de Shapiro-Wilk y las diferencias entre mediciones fueron estudiadas con la prueba de rangos con signo de Wilcoxon.

Resultados: En el AAHPERD Basketball Shooting Test, la media pasó de 3.77 ± 1.07 a 6.77 ± 1.07 tiros acertados (79.6 %). En el Basketball Field Goal Speed Spot Shooting Test la media pasó de 4,77 ± 1,07 7,77 ± 1,07 canastas (62,9 %). Los dos instrumentos mostraron diferencias muy significativas ($Z = -4.81$; $p < .001$).

Discusión: Los juegos adaptados facilitan el aprendizaje técnico al integrar exigencias motrices, perceptivas y cognitivas en situaciones reales de juego.

Conclusiones: El programa mejoró significativamente la precisión de lanzamiento, lo que lo convierte en una estrategia eficaz para la enseñanza del baloncesto en las edades tempranas.

Palabras clave: Aprendizaje motor; baloncesto; educación física; entrenamiento deportivo; rendimiento deportivo.

Introduction

Basketball is one of the most practiced and developed team sports in the educational and training environment, due to its contribution to the development of motor, perceptual, cognitive, and socio-emotional skills in young people and children. In the initial phases of sports initiation, mastering essential technical skills is crucial to promote the gradual learning of the game. Shooting at the hoop is the technical action that has the most impact on offensive effectiveness and competitive success. Its correct implementation includes the regulation of movement, decision-making, postural control, spatial perception, and motor coordination processes. These must be developed through methodologies that align with the developmental characteristics of children (Guimarães et al., 2019; Han et al., 2023; Song et al., 2022).

For decades, basketball shooting instruction has been primarily based on conventional techniques that emphasise the methodical repetition of the technical action in very controlled and isolated circumstances. Although these strategies allow the movement to be automated at first, they do not guarantee that the learning will transfer to real game situations, which are marked by uncertainty, environmental variability, and the need to react effectively to countless stimuli. Sports sciences have promoted pedagogical models focused on motor adaptation, contextualised learning, and constant interaction between the athlete and their practice environment to overcome these limitations. This has made competitive circumstances more representative (Gorovenko et al., 2020; Schelling & Torres-Ronda, 2016; Shalom et al., 2025).

The Constraints-Led approach, which is based on dynamic systems theory and ecological learning, has taken on a significant role within these recent methodological trends. According to the model, the interaction between the subject's constraints, the task, and the environment is what gives rise to motor behaviour. Therefore, if these limitations are intentionally manipulated, processes of self-organization of movement, adaptation, and exploration are favoured. Modified games, from this perspective, are a methodological tactic that has the ability to recreate situations that mimic real play. They help acquire technical skills by continuously solving motor problems and making decisions in changing circumstances (Arede et al., 2022; Shalom et al., 2025; Song et al., 2022).

The latest science reveals that performance in basketball is influenced by various technical, physical, and functional elements in a combined manner. Studies conducted with young players have shown that competitive performance and sports progress depend on biological maturation, physical condition, the quality of technical skills, and neuromuscular control. Moreover, the increase in dynamic stability, trunk

strength, and coordinative development enables a more effective and consistent technical execution in specific game actions (Guimarães et al., 2019; Gál-Pottyondy et al., 2025; Han et al., 2023).

Several studies have indicated, at the same time, that to optimise sports learning, it is necessary to incorporate technical-tactical demands and physical loads in a balanced manner in training planning. The control of internal and external loads, microdosing programming, and specific physical conditioning programs provide an improvement in the player's functional capacities without altering the adaptation process. In turn, they promote the growth of technical skills throughout the sports season. These findings demonstrate that, beyond the amount of training, what truly makes a difference is the methodological quality of the tasks (Rodríguez-Cayetano et al., 2023; Bonder & Shim, 2023; Gonçalves et al., 2025).

The most recent studies also emphasise the importance of incorporating training techniques that enhance the athlete's adaptive capacity and motor variability. In this context, deferred training, plyometric work, neuromuscular preparation, and the integration of perceptual-cognitive elements foster notable advances in technical and functional performance, especially throughout the phases of sports training. These methodologies improve the effectiveness of motor learning by subjecting the player to various practice circumstances, making it easier to transfer skills to real competition situations (Arede et al., 2022; Gómez-Carmona et al., 2026; Schelling & Torres-Ronda, 2016).

On the other hand, technological advancements have created new opportunities to teach basketball through intelligent simulation systems, biomechanical movement analysis, and virtual reality. Although its implementation is still restricted in sports schools and municipal programs due to economic and infrastructural limitations, these tools make objective evaluation, technical optimisation, and instant feedback processes possible. The technical and physical performance of athletes is also significantly affected by additional factors such as biomechanical efficiency and nutritional status, so sports training should be viewed from a multidimensional perspective (Wu, 2022; Tyoakaa et al., 2024; Yongsheng, 2015).

Despite the increase in scientific evidence regarding physical preparation, neuromuscular training, load control, and contemporary methodologies in basketball, there are still not many experimental studies that specifically examine the impact of modified games programs based on the Constraints-Led approach on shooting accuracy in school-aged children. Most of the research has been conducted with adolescents, high-performance athletes, or competitive categories, and there is still a lack of evidence in the contexts of sports initiation, especially in municipal institutions in Latin America. This scientific gap conditions the creation of methodological programs based on evidence that meet the real needs of children's motor development and the specific traits of teaching processes for basketball in young children.

In this context, the need to produce experimental evidence on the effectiveness of a modified games program through the Constraints-Led perspective as a novel strategy to enhance shooting learning in basketball during sports initiation makes this research meaningful. The findings will provide scientific bases for the creation of active methodologies that promote meaningful learning of technical skills and contribute to the strengthening of sports training procedures in school and municipal settings. Consequently, the aim of the study was to examine the impact of a modified games program based on the Constraints-Led approach on the shooting accuracy in basketball among 10-year-old children attending the Municipal School of Salitre, Ecuador.

Method

Design

The research was conducted with a quantitative approach, as it allowed for the objective measurement of changes in shooting accuracy as a result of a structured intervention. An explanatory perspective was employed, with the aim of establishing how a modified games program, based on the Constraints-Led methodology, influences the technical learning of shooting in basketball. Likewise, the study employed a pre-experimental pretest-posttest design (G: O_1 - X - O_2), in which the participants were examined before and after the intervention without incorporating a control group. This design allowed for the comparison of initial and final measurements in order to identify variations that could be associated with the implemented training program.

Variables

The modified games program, based on the Constraints-Led approach, was the independent variable. The latter is a method that seeks to facilitate the learning of throwing through the systematic manipulation of constraints in the task, the environment, and the performer. The purpose of developing the program was to promote decision-making, the adaptation of the technical gesture to different game conditions, environmental perception, and motor research, based on progressive playful situations.

The accuracy of the basketball shot was the dependent variable, which means the level of effectiveness achieved by the children when performing the shot towards the hoop, under standardised evaluation conditions. The following dimensions were taken into account for the study: shooting accuracy, which was evaluated through the number of successful shots; technical execution, which was measured by the proper performance of the biomechanical stages of the gesture (initial position, ball grip, body coordination, coordinated extension, and follow-through); and performance consistency, which was defined by the stability in execution during all attempts.

Participants

The children from the Municipal School of Salitre, in Ecuador, who regularly attended the basketball initiation sports program were the ones who made up the population. Given the small size of the population, a non-probabilistic convenience sampling technique was employed. All participants who met the selection criteria set for this study were included.

The sample consisted of 30 ten-year-old children who regularly participated in basketball practices and did not have any medical conditions or musculoskeletal injuries that would hinder their ability to play the sport. The inclusion criteria were as follows: being over ten years old, being enrolled in the Municipal School of Salitre, attending training sessions regularly, and having the informed consent signed by their legal representatives. Participants who did not complete any of the evaluations established in the research or who had more than 20% absences from the intervention program were excluded.

Procedure

The research was conducted in four phases. Informed consent was obtained from the legal representatives of the participants and authorisation from the Administration of the Municipal School of Salitre, ensuring that ethical principles for research involving minors were met. An evaluation of the children was conducted to verify if they met the defined inclusion criteria, and the schedule for interventions and assessments was established.

The second stage consisted of conducting the pretest, which aimed to determine the baseline level of throwing accuracy and the quality of technical execution. With the purpose of standardising the measurements, the tests were conducted on the track of the Municipal School of Salitre, using the same space, sports equipment, schedule, and method for all participants.

Phase three was related to the implementation of the modified games program, which is based on the Constraints-Led approach. This was created to facilitate the learning of throwing by systematically altering the constraints of the performer, the task, and the environment. The intervention lasted eight weeks, with three 60-minute sessions per week, totalling 24 sessions. Each session was divided into three stages: 10 minutes of warm-up, 45 minutes of modified games, and 5 minutes to cool down.

The program was divided into four successive parts, each lasting two weeks. The first block focused on familiarisation with the technical gesture, through games that aimed at ball control, hand-eye coordination, and spatial orientation. For this, lighter balls, short distances, and no opposition were used. In the second stage, to allow the motor pattern to adapt to different contexts, the complexity was increased by modifying the execution angles, the time available to throw, the throwing distances, and the prior movements. The third block incorporated activities with passive opposition and teamwork through small-sided games that required receiving, deciding, and shooting under time pressure. Finally, in the fourth block, small-sided games (2×2 and 3×3) were conducted in which the constraints were constantly changed, altering the space, the rules, the number of authorised passes, the shooting areas, and the possession time. The objective was to promote decision-making and the transfer of learning to real game situations.

The most important factors that were adjusted during the program were: the height of the hoop (from 2.60 to 3.05 m), the shooting distance (from 2 to 4 m), the weight and size of the ball, the playing area, the number of players, the execution time, the level of opposition, and the specific rules for each task. The objective of these changes was to promote the search for various motor solutions, thus avoiding the mechanical repetition of the technical movement.

The training load was gradually adjusted, slowly increasing the complexity and volume of the tasks. In each session, between 80 and 120 throws were executed, in groups of 8 to 10 repetitions with a recovery period of 30 to 60 seconds. A moderate intensity was maintained, determined by the degree of opposition presented and the continuity of the tasks. The methodological evolution was in line with the principles of representativeness, specificity, and variability of motor learning, which are characteristic of the Constraints-Led approach.

From a didactic perspective, the global method was applied as the main strategy, promoting learning through game-representative contexts. Additionally, guided discovery and problem-solving were used to encourage participants to recognise and modify the most effective motor alternatives on their own in response to the different constraints set by the coach. At the end of each task, individual and group feedback was provided, emphasising guidance on the impact of movement rather than isolated technical correction.

To ensure that the measurements were comparable, the same protocol used in the pretest was employed to conduct the posttest at the end of the intervention. As a final step, the data were coded and organised into a database so that they could later be processed statistically.

Instruments

To measure shooting accuracy, the AAHPERD Basketball Shooting Test was used, which is a widely used standardised test to assess shooting effectiveness in basketball players during developmental stages. The test consists of making a series of shots from predefined locations around the hoop and recording the total number of baskets made. In the present study, a protocol was employed that was tailored to the characteristics of 10-year-old children, maintaining standardised conditions regarding the height of the hoop, the throwing distance, the type of ball, and the evaluation method. One point was awarded for each successful shot in order to measure shooting accuracy quantitatively (American Alliance for Health, Physical Education, Recreation and Dance [AAHPERD], 1984).

In the battery of tests to evaluate performance in physical education, the Basketball Field Goal Speed Spot Shooting Test, suggested by Johnson and Nelson, was used as an additional measure of performance. This instrument allows for an objective measurement of shooting effectiveness by recording how many baskets are made from different positions within a specific time period. This

provides an objective indicator of technical performance under standardised conditions (Johnson & Nelson, 1986).

Data analysis

The statistical package IBM SPSS Statistics version 29.0 was used to perform the statistical analysis. To describe the behaviour of the variables analysed before and after the intervention, a descriptive analysis was conducted, which involved calculating frequencies, percentages, means, and standard deviations.

Since the sample contained fewer than 50 participants, the Shapiro-Wilk test was subsequently used to verify the assumption of normality of the data. The results revealed that the studied variables showed significance values below 0.05 ($p < 0.05$), which suggests that the data did not follow a normal distribution. For this reason, the non-parametric Wilcoxon signed-rank test was used to compare the measurements obtained in the pretest and posttest. This test is appropriate for dependent samples when the assumptions of normality are not met. In all evaluations, a statistical significance level of $\alpha = 0.05$ was determined. Statistically significant differences were considered when the p-value was below the established criterion.

Results

Table 1. *Descriptive statistics for the AAHPERD Basketball Shooting Test before and after the intervention*

Statistic	Pretest	Posttest
Mean	3.77	6.77
Median	4.00	7.00
Standard deviation	1.07	1.07
Variance	1.15	1.15
Standard error	0.20	0.20
Minimum	2	5
Maximum	6	9
Range	4	4
25th percentile	3.00	6.00
75th percentile	4.75	7.75

Note. Descriptive statistics for the AAHPERD Basketball Shooting Test administered before and after the modified games program based on the Constraints-Led approach.

Table 2. *Shapiro–Wilk normality test for the AAHPERD Basketball Shooting Test*

Variable	W	df	Sig.
Pretest	0.910	30	.019
Posttest	0.910	30	.019

Note. Significance values lower than .05 indicate violation of the normality assumption.

Table 3. *Wilcoxon signed-rank test for the AAHPERD Basketball Shooting Test*

Ranks	n	Mean rank	Sum of ranks
Negative ranks	0	0.00	0.00
Positive ranks	30	15.50	465.00
Ties	0	—	—
Test statistic		Value	
Z		-4.81	
Asymptotic significance (two-tailed)		< .001	

Note. All participants improved their scores in the posttest; therefore, only positive ranks were observed.

Table 4. *Descriptive statistics for the Basketball Field Goal Speed Spot Shooting Test before and after the intervention*

Statistic	Pretest	Posttest
Mean	4.77	7.77
Median	5.00	8.00
Standard deviation	1.07	1.07
Variance	1.15	1.15
Standard error	0.20	0.20
Minimum	3	6
Maximum	7	10
Range	4	4
25th percentile	4.00	7.00
75th percentile	5.75	8.75

Note. Descriptive statistics for the Basketball Field Goal Speed Spot Shooting Test.

Table 5. *Shapiro–Wilk normality test for the Basketball Field Goal Speed Spot Shooting Test*

Variable	*W*	*df*	*Sig.*
Pretest	0.910	30	.019
Posttest	0.910	30	.019

Note. The data did not meet the assumption of normality ($p < .05$).

Table 6. *Wilcoxon signed-rank test for the Basketball Field Goal Speed Spot Shooting Test*

Ranks	n	Mean rank	Sum of ranks
Negative ranks	0	0.00	0.00
Positive ranks	30	15.50	465.00
Ties	0	—	—
Test statistic		Value	
Z		-4.81	
Asymptotic significance (two-tailed)		< .001	

Note. All participants improved their performance following the intervention.

Table 7. *Comparison of the effects of the modified games program across both assessment instruments*

Instrument	Pretest (M ± SD)	Posttest (M ± SD)	Absolute increase	Improvement (%)	p
AAHPERD Basketball Shooting Test	3.77 ± 1.07	6.77 ± 1.07	3.00	79.6	< .001
Basketball Field Goal Speed Spot Shooting Test	4.77 ± 1.07	7.77 ± 1.07	3.00	62.9	< .001

Note. Differences between pretest and posttest scores were analyzed using the Wilcoxon signed-rank test.

The modified games program, which is based on the Constraints-Led approach, facilitated a notable improvement in shooting accuracy after using the AAHPERD Basketball Shooting Test. The average score changed from 3.77 ± 1.07 in the pretest to 6.77 ± 1.07 in the posttest, which means a total increase of 3.00 hits and a relative improvement of the initial performance of 79.6%. Likewise, the median increased from 4.00 to 7.00 correct answers, the minimum value from 2 to 5, and the maximum from 6 to 9; this demonstrates that all participants improved, not just those with initially higher performance.

For the pretest and posttest, the Shapiro-Wilk normality test yielded a W value of 0.910 and a significance of $p = .019$. Therefore, it is determined that the scores did not have a normal distribution ($p < .05$). Therefore, the Wilcoxon signed-rank test was used to compare the correlated measurements. The findings indicated that the two assessments had very marked differences ($Z = -4.81$; $p < .001$), which leads to rejecting the null hypothesis and confirming that the program had a favourable impact on throwing accuracy. The rank analysis revealed that the 30 participants obtained positive ranks, with no ties or negative ranks; this reflects that all the children improved their performance after the intervention.

The program also led to a significant improvement in the Basketball Field Goal Speed Spot Shooting Test. The mean increased from 4.77 ± 1.07 baskets in the pretest to 7.77 ± 1.07 in the posttest, which implies a relative improvement of 62.9% and an absolute increase of 3.00 baskets. The median increased from 5.00 to 8.00, and the range of scores changed from baskets 3-7 before the intervention to baskets 6-10 after the program, indicating an improvement in the technical performance of all participants.

The distribution of the data also turned out not to be normal according to the Shapiro-Wilk test ($W = 0.910$; $p = .019$), so the Wilcoxon test was used to compare the two measurements. The analysis revealed statistically significant differences between the pretest and posttest ($Z = -4.81$; $p < .001$), with 30 positive ranks recorded, no ties, and no negative ranks. These findings indicate that at the end of the intervention program, the participants increased the number of accurate throws.

The comparative examination of the two instruments revealed consistent technical performance. The initial scores of the two tests were different due to their individual characteristics; however, after the intervention, both recorded an absolute increase of 3 points. The highest improvement percentages were found in the Basketball Field Goal Speed Spot Shooting Test (62.9%), followed by the AAHPERD Basketball Shooting Test (79.6%). For both instruments, the difference was highly significant ($p < .001$). The absence of negative ranges and the uniform improvement of all participants indicate that the modified games program, based on the Constraints-Led perspective, promoted a stable and extended learning process, which increased the throwing accuracy among 10-year-old children at the Municipal School of Salitre.

Discussion

According to the findings of this research, the implementation of an adapted games program based on the Constraints-Led perspective produced notable advances in the shooting of 10-year-old children, with sustained increases in the scores achieved in the AAHPERD Basketball Shooting Test and

Basketball Field Goal Speed Spot Shooting Test. These findings suggest that the systematic manipulation of task, environment, and performer constraints benefited processes of motor exploration, perceptual-motor adaptation, and movement self-organization. These latter are fundamental characteristics of the Constraints-Led perspective.

The findings are consistent with the evidence presented by Komotska and Sushko (2022), which demonstrated that a structured physical conditioning program applied during the pre-competitive period resulted in a notable improvement in speed and explosive strength indicators in young basketball players, especially if the training loads focused on performance quality rather than volume increase. Although the first study focused on physical skills and the second on shooting accuracy, both demonstrate that a specific plan for tasks and the adjustment of loads to the athletes' developmental particularities contribute to positive improvements in sports performance.

Likewise, the results obtained by Munadi et al. (2022) align with the improvements observed in shooting accuracy, who discovered that a scientifically designed exercise program generated significant advances in physical skills and two-point shooting efficiency in young basketball players. The similarity between the two studies supports the relevance of employing structured and progressive programs, but this study provides additional evidence: that these improvements can be achieved through the use of adapted games based on the Constraints-Led approach. This simultaneously enables better motor adaptation and more effective decision-making in game-representative circumstances.

The results are also supported by the studies of Li et al. (2026) from a neurocognitive perspective, which showed that a twelve-week cognitive-coordinative training program produces a notable improvement in the technical skills and specific physical condition of adolescent players ($p < .001$). The authors argue that if coordination and cognitive processes are integrated, it is possible to perfect technical execution under conditions of high perceptual demand. The methodological logic of the Constraints-Led approach, which holds that learning comes from the constant interaction between perception, action, and decision-making, is compatible with this proposal. This may be what causes the uniform improvement found in all subjects of the current study.

Following the same line, Lucia et al. (2024) demonstrated that incorporating dual cognitive-motor tasks into training sessions improved agility, speed, and the neural processes linked to motor preparation. Although the research was conducted with highly skilled athletes and examined different variables, both studies agree that incorporating cognitive demands throughout sports practice optimises the quality of motor learning and drives more effective technical execution. In the current research, the lasting alterations in space and rules, as well as the trajectories and terms of the throw, forced the children to constantly solve motor problems, which fostered similar processes of functional adaptation.

Moreover, the results are consistent with the claims of the scoping review conducted by Shalom et al. (2025), which found that training techniques that integrate cognitive, perceptual, and physical elements are one of the most promising trends for enhancing basketball performance. The authors particularly highlight the possibility of simultaneously maximising technical performance and the ability to react to the changing circumstances of the game through cognitive-motor training and multi-component programs. The program used in this research aligns exactly with this integrative approach, merging technical tasks with constraints that gradually increase the complexity of perception and decision-making.

On the other hand, Song et al. (2022) state that, although agility is closely linked to the proper development of technique in the game, it is often an element that is underestimated in basketball training. From this perspective, the increase in shooting accuracy can be considered not only as a result of the perfection of the technical gesture but also as a consequence of a better ability to regulate body movements in response to the constant variations in execution conditions that are characteristic of the modified games used during the intervention.

The current study did not directly evaluate the external training loads, but its findings should be interpreted considering the data provided by Kutson et al. (2024), who noted that young basketball players experience significant changes in load during the season, especially in phases with a higher

number of games. In this sense, using adapted games is a methodological alternative that allows for the simultaneous development of technical and cognitive skills through regulated loads appropriate to the participants' level of maturation, which is particularly important in the early stages of training.

Likewise, the individual analysis of performance makes it possible to create tasks more tailored to the particular demands of each player, as indicated by Lin and Li (2026) in their study on recent personalised training systems. Although the present study did not include personalisation algorithms, the principle of individualisation was maintained through the gradual modification of task constraints, allowing each participant to find motor solutions appropriate to their own abilities, one of the pillars of the Constraints-Led approach.

Finally, some recent studies suggest incorporating emerging technologies with the aim of improving technical learning. Wu (2022) proposes that virtual simulation systems have the potential to enhance throwing training through controlled interactive scenarios; for his part, Yongsheng (2015) emphasises the relevance of biomechanical analysis to achieve technical improvement in the sports gesture. The study presented here, despite being conducted using traditional pedagogical resources and not advanced technologies, shows that deliberately managing game constraints is an effective and simple tactic to implement in sports schools with limited resources. In this regard, it is recommended that future studies make use of the Constraints-Led perspective and technological instruments for biomechanical study and virtual simulation, with the aim of further perfecting the learning of the throw.

Conclusions

The 10-year-old children from the Municipal School of Salitre achieved significant progress in their basketball shooting accuracy thanks to the implementation of the modified games program, which is based on the Constraints-Led approach. The discrepancies found between the pretest and posttest in the AAHPERD Basketball Shooting Test and Basketball Field Goal Speed Spot Shooting Test, corroborated through the Wilcoxon signed-rank test ($p < .001$), demonstrate that the intervention promoted effective technical learning and uniform progress among all participants, which validates the effectiveness of the program as a pedagogical strategy during the initiation of the sport.

The findings support the idea that the Constraints-Led approach can be a novel methodological option for teaching basketball shooting, as it fosters processes of motor exploration, perceptual-motor adaptation, and decision-making through the systematic management of environmental, performer, and task constraints. The use of modified games enabled the development of technical skills in scenarios that reflect the game, allowing for more practical and transferable learning to real competition circumstances.

The findings of the research, from a practical perspective, provide evidence supporting the incorporation of modified game programs in the educational processes of youth sports. This is because these programs allow for the improvement of technical learning without excessively overloading the training sessions. In order to establish the persistence of the observed effects and study the repercussions of the Constraints-Led approach on other tactical, technical, and cognitive basketball skills, it is suggested that future research increase the intervention time, include control groups, have larger samples, and conduct follow-up evaluations.

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Conflict of interest

The author declares no conflict of interest.

Author contributions

Author 1: conceptualisation, research, project administration, writing, review, validation, and editing.

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