INTEGRATING AUDIO-VIDEO TECHNOLOGY IN TEACHING CHILDREN THE LONG JUMP AND OINA BALL THROW

Andreea GEORGESCU[1*], Aura BALABAN[1], Adrian GEORGESCU[2], Antoanela OLTEAN[2]

[1] National University of Physical Education and Sport, Faculty of Physical Education and Sport, Bucharest, Romania
[2] Ovidius University, Faculty of Physical Education and Sport, Constanța, Romania
*Corresponding author: andreeaalexandra434@gmail.com

https://doi.org/10.35189/dpeskj.2022.61.3.6

Abstract. *The purpose of the research was to highlight the effect produced by audio-video technology on the training process conducted in two athletics events by using rating scales for technical execution, which were completed by the coach after watching the videos recorded for each participant. At the initial and final assessments, the investigated athletes performed two tests, namely the running long jump and long throw of the oina ball (140 g), which were video-recorded to measure their performance in meters. The videos recorded in the two testing phases and the two rating scales were used as tools for the assessment of technical execution. The study participants were 12 girls aged between 9 and 10 years. The training programme was implemented from September 2021 to July 2022, involved three training lessons per week and included daily 10-minute viewings of technical execution. The results of the athletes participating in the research highlighted progress in both the technical execution at all moments established by the rating scales and the performance achieved in the two tests. There was a significant difference with a large effect size between the initial and final assessments of the running long jump and long throw of the oina ball (r = 0.88).*

Keywords: *training model, rating scales, long jump, oina ball throw, audio-video technology.*

Received: *18 June 2022 /* **Revised:** *9 September 2022 /* **Accepted:** *27 September 2022 /*
Published: *30 September 2022*

Introduction

Improving motor skills throughout childhood and adolescence to maximise athletic success in adulthood is not a novel approach, but one that has been of increasing concern to specialists in recent years. The modern theory and methodology of sports training, as part of the general development of teaching technology, tends to constantly enrich and improve the ways of acting on the child. The traditional approach to sports training, which is mainly focused on obsolete theories, concepts, laws and ideas that are largely subordinated only to classical didactic rationales, has become ineffective to cope with the current trends in world sports performance. The road towards achieving top sports results is long, difficult and uncertain. Athlete development models differ in the specific aspect of individual sports. The emphasis is placed on the holistic approach to children education. Game-based training

should be used because it is motivating and involves positive emotions (Malina, 2010; Vaeyens et al., 2008). The training of 9-10-year-old girl athletes participating in our study is also oriented in this direction.

The training process is not random but relies on well-structured and carefully developed models. The model is a conventional picture of the investigated object, which is built by an individual who aims to accomplish a precise goal of the research carried out (Ursanu et al., 2008). In other words, the model is a predictive picture of an activity, in our case, the training process. The concepts of model and modelling, along with other highly topical concepts of modern technology, have become characteristic elements of both scientific research and psycho-pedagogical processes. Modelling is a way of improving and making the activity more efficient.

Athletics also keeps pace with the progress of modern technology, which is why designing training models for different categories of participants and situations is a concern of sports coaches (Bădescu et al., 2022). Among the elements that allow talent identification, the most important is the progress rate of sports performance (Brazo-Sayavera et al., 2017). In order to accomplish the proposed goals, the training of children and adolescents should be designed in a long-term vision so that its different stages can be adapted to the characteristics of each age (Fishman & Dede, 2016). Sports competition, in general, represents the assessment at the end of a training cycle but also the materialisation of the coach and athlete's work in a result or performance. The progress rate of performance in an official goal-focused competition influences the increase in value of the training model indicators. Sports training models are concretised in the design of training lesson plans, weekly microcycles, stage plans and the annual or multiannual training plan (Baiqi, 2022). The need to approach models in the training of beginner and advanced athletes is related to the rigorous observance of methodological sequences when learning and consolidating technical elements and procedures in athletics but mostly to the correct acquisition of execution techniques.

Sports performance, as a result of motor ability, is the outcome of a set of predominantly motor manifestations (abilities, skills) that depend on the development levels of motor qualities, morpho-functional indices, mental (cognitive, affective, motivational) processes and biochemical metabolic processes, which are all aggregated, correlated, mutually conditioned and lead to the efficient execution of the actions and acts required by the specific conditions of practising motor activities (Dragnea & Bota, 1999). Based on this consideration, we consider it necessary to conduct an experimental research on how athletes achieve sports performance.

Athletics, which is rightly called the "king of sports", is a sports discipline that has been practised and mentioned since ancient times. It included a small number of events in the Ancient Olympics and has developed into many events in the modern Olympics (Stoica, 2000), and this number is still growing today. Improving the training process is a continuous action by which coaches constantly enhance the means and methods of training by adapting them to the needs and levels of their athletes. In our contemporary society, the use of audio-video technology for children is a necessity imposed by the explosion of software programs, games and types of devices, which is why it has become a current way of working. The acquisition of a correct technique depends on motor control, and this idea has already been accepted in the field of sports training, namely that actions are mentally represented in

functional terms as a combination of the performed action and the intended or observed effect (Čoh et al., 2004; Land et al., 2013). Given these considerations, the use of audio-video technology in the training of children is a way of facilitating perception and understanding as well as strengthening the acquisition of execution techniques in athletics events.

Coaches can also track the development of athletes' individual skills. By recording performance over a period of time and creating a video library, coaches can show athletes the clear picture of their technical execution at a given point or their progress/regression at certain times. This can represent a type of feedback and serve as motivation for athletes (Harris et al., 2020). Video recording and watching any individual execution, together with the possibility of repeating this process an infinite number of times, is a method that can be used in the training of children for the clear mental representation of a technical execution and implicitly the improvement of technical indices.

Problem statement

Execution technique in athletics events is the key to obtaining sports performance, and the formation of execution and assessment skills can be achieved with the help of audio-video technology but also by knowing and using rating scales.

Research purpose

Bruton and Wright (2022) start from the idea that "in addition to physical practice, athletes can use a technique called action observation to help themselves improve" (p. 1) and point out that "watching movements activates similar parts of the brain to those that are involved in performing movement" (p. 1), "action observation is part of everyday life and […] helps with performance of sports skills" (p. 5), "action observation can help athletes with important psychological factors, such as confidence", "action observation combined with physical practice is an excellent way to help athletes of all skill levels to get better at their sports" (p. 5). Based on these considerations, we decided to use, in both the training and assessment of athletes, video recordings of the practical execution and two technical execution assessment scales, with each one structured in six moments designed by us.

The purpose of the present study was to highlight the effect produced by audio-video technology on the training process conducted in two athletics events by using rating scales for technical execution.

Research hypotheses

In carrying out this research, we aimed to verify the following hypotheses:

H1: There are statistically significant positive correlations between technical training indices and athletes' performance in the running long jump and oina ball throw events.

H2: There is a statistically significant difference between the initial and final test results after the experimental intervention as regards technical execution and athletes' performance in the running long jump and oina ball throw events.

Methodology

Participants and Procedure

The training programme and athlete assessment were conducted at the stadium in Medgidia, Constanța County, between September 2021 and July 2022. After 10 March 2022, when school activities had to be carried out online, the training took place on the outdoor sports field in strict compliance with two requirements, namely a distance of at least 6 m between participants and working with own material (the oina ball, weighing 140 grams). The target group included in the research consisted of 12 girls aged 9-10 years, who had at least 6 months of training in athletics. For participation in the study and publication of the results, written informed consent was obtained from the athletes' legal guardians, thus respecting the ethical principles of scientific research.

The research methods used were: literature review, pedagogical observation, experiment, mathematical statistics and graphical method.

Assessment protocol

The instrument used at the initial and final assessments consisted in performing two video-recorded practical tests and completing two rating scales, one for the running long jump and the other for the oina ball throw. Based on watching the videos, the coach assessed the technical execution using the rating scales that included six technical moments representing certain movement characteristics. Therefore, each rating scale was structured into six moments, and each moment was assessed for three execution levels that were awarded 1, 3 and 5 points corresponding to the "satisfactory", "good" and "very good" ratings. According to the running long jump rating scale, the three categories of points and ratings were awarded for the following six moments: *approach run action, take-off action, flight action, landing action, action of leaving the landing area, overall running long jump action*. The oina ball throw rating scale consisted in awarding the three categories of points and ratings for the following six moments: *approach run action, trunk twisting action during the throwing steps, throwing arm action, free arm action, ball release and balancing action, overall oina ball throw action.*

With the help of the two scales, the coach assessed the technical execution of each athlete after watching the video recordings. Performance assessment and monitoring were achieved by video recording each individual execution, watching the videos and completing the rating scales. The values awarded by the coach to the items of the two rating scales after watching the videos were recorded, processed and interpreted, which allowed highlighting the technical and performance progress in the training process.

For data processing and interpretation, we used the statistical software for Office Excel from the Microsoft Professional Plus 2013 package, with which the following indicators were calculated: mean value; standard deviation; coefficient of variation. We also used non-parametric statistical tests, namely Spearman's correlation and the Wilcoxon test.

The training process was conducted according to a model. The designed training model applied to the target group focused on the multilateral training of children and included

simple and complex exercises for the development of motor skills and exercises for learning the two athletics events, which are acquired, strengthened and perfected at this age.

Table 1. *Structure and content of the training model implemented between September 2021 and July 2022*

Stage	Meso-structure	Venue	Training lessons	Days off	No. of (official or friendly) competitions	No. of training hours	No. of physical training hours	No. of technical training hours	No. of tactical and theoretical training hours	No. of video analysis hours
Basic training	**MZC 1 –** adaptation	MEDGIDIA	13	17	1	26	18	6	2	2/2
	MZC 2 – basic		27	36	0	54	39	12	3	4/3
	MZC 3 – basic		32	40	0	64	48	12	4	4/4
Pre-competition	**MZC 4 –** precompet.		12	16	0	24	12	10	2	2/2
Competition	**MZC 5 –** compet.		17	12	6	34	10	20	4	3/3
Recovery	**MZC 6 –** recovery		6	8	0	12	8	-	4	1/1
Basic training	**MZC 7 –** basic		6	9	0	12	7	4	1	1/1
Pre-competition	**MZC 8 –** precompet.		8	9	1	16	4	10	2	2/1/1
Competition	**MZC 9 –** compet.		4	5	1	8	2	5	1	1/1/1
Recovery	**MZC 10 –** active rest		13	17	0	26	22	0	4	0

The training programme aimed to improve children's motor skills in the two athletic events. The training model had as objective to improve motor skills by using practical means (physical exercise) but also audio-video technology, which was intended to create the opportunity of watching and re-watching the technical execution in order to perceive and understand the way of achieving it. Thus, the technical execution of the two events through exercises with technical tasks was improved by video recording each athlete's performance and then watching it, by analysing the technical execution based on watching the specific moments of the two events as provided in the rating scales and by watching videos of valuable athletes. The training model covered eight stages with ten mesocycles (Table 1) during which the athletes performed three training sessions per week. The research lasted eight months, starting in September 2021 with the initial assessment, which was followed by the implementation of the training programme until July 2022 when the final assessment took place.

Results

The assessments were made by the coach based on watching the recorded videos and completing the rating scales developed by us for the two events included in the study.

Results obtained for the running long jump

The results of technical execution based on the six moments and following the assessments made after watching the videos and completing the rating scales at the beginning and the end of the training period can be found in Table 2 and Figure 1.

Table 2. *Results of technical and performance assessments for the running long jump*

Indices		Test	ARA (pts)	ToA (pts)	FA (pts)	LA (pts)	ALLA (pts)	RLJ (pts)	Total points out of 30		Performance (m)
									Points	%	
$\bar{X}$		IT	2.50	2.83	4.16	4.83	5.00	2.50	21.75	72.50	3.44
		FT	3.66	4.66	4.83	4.83	4.66	4.66	27.33	81.99	3.85
		Dif.	1.16	1.83	0.67	0	-0.34	2.16	5.58	18.60	0.41
SD		IT	0.90	1.03	1.33	0.57	0	0.90	3.47		0.38
		FT	0.98	0.77	0.57	0.57	0.77	0.77	2.99		0.40
Max		IT	3	5	5	5	5	3	24		4.06
		FT	5	5	5	5	5	5	30		4.53
Min		IT	1	1	1	3	5	1	14		2.70
		FT	3	3	3	3	3	3	22		3.10
Ratings %	S	IT	25	16.67	8.33	-	-	25			
	G		75	75	25	8.33	-	75			
	VG		-	8.33	66.67	91.67	100	-			
	S	FT	-	-	-	-	-	-			
	G		66.67	16.67	8.33	8.33	16.67	16.67			
	VG		33.33	83.33	91.67	91.67	83.33	83.33			

Legend: ARA = approach run action; ToA = take-off action; FA = flight action; LA = landing action; ALLA = action of leaving the landing area; RLJ = running long jump; S = satisfactory = 1 point; G = good = 3 points; VG = very good = 5 points; pts = points; IT = initial test; FT = final test; Dif. = difference between the initial and final test.

The initial test provides an overview of the technical execution levels and reflects poor technique, especially in the first two moments of the event but also in the overall execution of the running long jump. The mean score (total points for technical execution) is 21.75 points in the initial test and 27.33 points in the final test (out of the maximum of 30 points), representing 72.2% and 81.99%, respectively, which shows an improvement in technical execution. The maximum value is 24 points in the initial test and 30 points in the final test, while the minimum value is 14 points in the initial test and 22 points in the final test. The participants improved their technical execution by 18.60%, which is a particularly important aspect for achieving sports performance. The standard deviation is not different between the two assessments, so there is no decrease in the homogeneity of the group.

We believe that after applying the programme and watching videos of own execution, the technique and awareness of defective moments have improved.

Analysing the results of the six moments (Table 2), it can be observed that their mean values are better in the final test compared to the initial test by: 1.16 points for the approach run action; 1.83 points for the take-off action; 0.67 points for the flight action; 2.16 points for the running long jump; 5.58 points for the total points accumulated. Identical values can be noticed for the landing action, which indicates that the athletes have not improved their technical execution throughout the study. For the action of leaving the landing area, the

technical execution recorded a regression of -0.34 points in the final test. We believe that the implemented programme needs to be revised so that the two actions of the running long jump event can be improved in terms of technical execution.

Regarding sports results (achieved performance), it can be observed that the mean value is 3.44 m in the initial test and 3.85 m in the final test, so there is an increase of 0.41 m. The participants' ratings corresponding to the scores awarded for each assessed moment show that no athlete falls into the "satisfactory" category in the final test where they are rated "very good" with a percentage of over 83.00%, except for the first moment where the percentage is 33.33%.

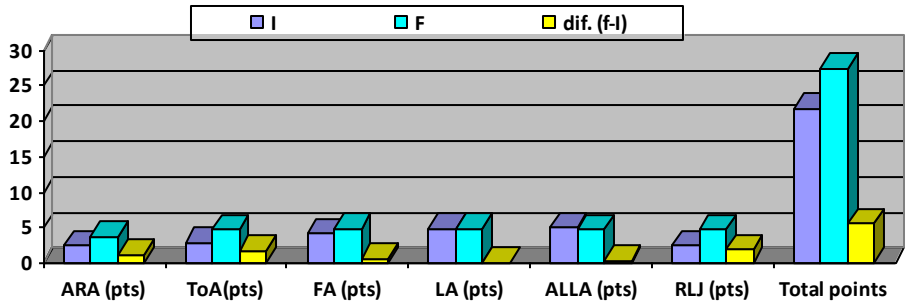

Figure 1. Differences in average progress scores for the running long jump according to the analysed technical moments

Table 3. *Spearman's correlation values for the technical training indices of 9-10-years-old children performing the running long jump event – Final test*

Actions	ARA	ToA	FA	LA	ALLA	RLJ
Total points	.657*	.831**	.561**	.561**	675*	.675*
Performance	.499	.426	-.016	.591	195	.646*
No. of viewing hours	.691*	-.282	-.026	-.026	.484	.484

Legend: ARA = approach run action; ToA = take-off action; FA = flight action; LA = landing action; ALLA = action of leaving the landing area; RLJ = running long jump. *Note:* *p < .05; **p < .01.

After calculating Spearman's correlation values obtained by the research group in the final test (Table 3), we found correlations between the following moments:

- a very high statistically significant positive correlation (where r ϵ [0.8; 1]) between the take-off action and total points (r = .831, p < .01);
- high statistically significant positive correlations (where r ϵ [0.6; 0.8]) between the approach run action and total points (r = .657, p < .05), the action of leaving the landing area and total points (r = .675, p < .05), the running long jump and total points (r = .675, p < .05) and the performance achieved (r = .646, p < .05).

Correlating the number of viewing hours with the actions provided in the running long jump rating scale, a high statistically significant positive correlation with the approach run action (r = .691, p < .05) was obtained.

Results obtained for the oina ball throw while running

The results of technical execution based on the scores achieved and the assessments made after watching the videos and completing the rating scales at the beginning and the end of the training period can be found in Table 4 and Figure 2.

Table 4. *Results of technical and performance assessments for the oina ball throw while running*

Indices		Test	ARA (pts)	TTA (pts)	TAA (pts)	FAA (pts)	BRBA (pts)	OBT (pts)	Total points out of 30		Performance (m)
									Points	%	
X		IT	3	2	3.66	3.16	2.5	2.5	16.83	56.10	15.00
		FT	4.83	4.16	4.33	4	4.33	4.83	26.50	83.33	29.00
		Dif.	1.83	2.16	0.67	0.84	1.85	2.33	9.67	27.23	14.00
SD		IT	1.21	1.35	0.98	1.81	1.51	1.24	6.68		2.82
		FT	0.57	1.03	0.98	1.04	0.98	0.57	4.18		4.59
Max		IT	5	5	5	5	3	5	28		10
		FT	5	5	5	5	5	5	30		22
Min		IT	1	1	3	1	1	1	8		20
		FT	3	3	3	3	3	3	18		35
Ratings %	S		16.67	58.34	-	33.33	41.67	33.33			
	G	IT	66.66	33.33	66.67	25	41.67	58.34			
	VG		16.67	8.33	33.33	41.67	16.66	8.33			
	S		-	-	-	-	-	-			
	G	FT	8.33	41.67	33,33	50	33,33	8.33			
	VG		91.67	58.33	66.67	50	66.67	91.67			

Legend: ARA = approach run action; TTA = trunk twisting action during the throwing steps; TAA = throwing arm action; FAA = free arm action; BBRA = ball release and balancing action; OBT = oina ball throw; S = satisfactory = 1 point; G = good = 3 points; VG = very good = 5 points; pts = points; IT = initial test; FT = final test; Dif. = difference between the initial and final test.

The obtained results indicate a mean score of 16.83 points in the initial test and 26.50 points in the final test (out of the maximum of 30 points), which represents 56.10% and 83.33%, respectively. These results show an improvement in technical execution after applying the motor programme and watching videos of great athletes and own videos. Repeated viewing and practice led to correcting poor times and awareness of oina ball throw while running.

The maximum value is 28 points in the initial test and 30 points in the final test, while the minimum value is 8 points in the initial test and 18 points in the final test. The participants improved their technical execution by 27.23%, which is a particularly important aspect for achieving sports performance. The standard deviation has a lower value in the final assessment compared to the initial assessment, which shows an improvement in the homogeneity of the group.

Analysing the results of the six moments, it can be observed that the mean values are better in the final test compared to the initial test (Table 4).

Regarding sports results, the mean value is 15.00 m in the initial test and 29.00 m in the final test, so there is an increase of 14 m. The maximum value is 2 m better in the final test than in the initial test, and the minimum value is 10 m lower in the initial test than in the final

test (for Total points). The participants' ratings corresponding to the scores awarded for each assessed moment reveal that no athlete falls into the "satisfactory" category in the final test where they are rated "very good" with percentages between 50.00% and 91.67%.

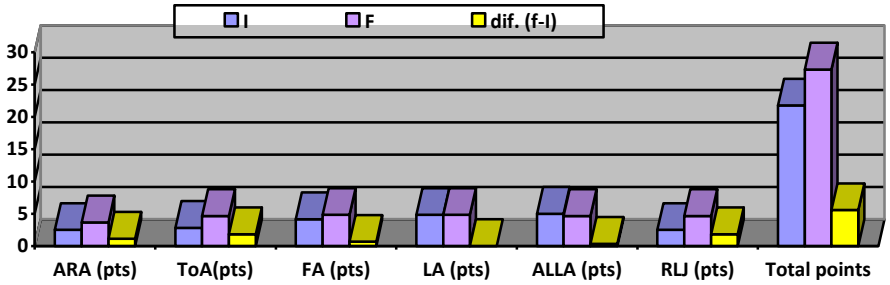

Figure 2. Differences in average progress scores for the oina ball throw according to the analysed technical moments

Spearman's correlation values obtained by the research participants for the technical moments of the oina ball throw are shown in Table 5.

Table 5. *Spearman's correlation values for the technical moments of the oina ball throw in 9-10-year-old girls*

Actions	Group	ARA	TTA	TAA	FAA	BRBA	OBT
Total points		.639*	.864**	.882**	.873**	.793*	.639*
Performance		.274	.192	.080	.121	.121	.274
No. of viewing hours		-.057	.560*	.262	.560*	.128	-.057

Legend: ARA = approach run action; TTA = trunk twisting action during the throwing steps; TAA = throwing arm action; FAA = free arm action; BRBA = ball release and balancing action; OBT = oina ball throw. *Note:* *p < .05; **p < .01.

The total score resulting from the assessment of video-recorded executions, according to the presented rating scale, indicates very high and high statistically significant positive correlations with three constitutive actions of the oina ball throw event. Total points correlate well with the trunk twisting action (r =.864, p < .01), throwing arm action (r = .882, p < .01), free arm action (r =.873, p < .01), ball release and balancing action (r =.793, p < .05) and oina ball throw (r =.639, p < .05), while the total number of viewing hours correlates well with the throwing arm action and ball release and balancing action. The obtained values confirm the appropriateness of our intervention of implementing audio-video technology in the training of 9-10-year-old children, which is demonstrated by their improved technical execution and awareness of the actions that compose the oina ball throw event.

Given the reduced number of participants, the non-parametric Wilcoxon test was chosen to compare two paired samples, as a statistical strategy for quantitative data analysis. The results obtained after applying the Wilcoxon test are shown in Table 6.

Table 6. *Wilcoxon test results*

Test	Indicator/ Test	Initial mean values	Final mean values	Wilcoxon	Efect size (r)
1	RLEepEx	21.75	27.33	Z = -2.969, p = 0.003	0.85
2	MoepEx	16.83	26.66	Z = -3.069, p = 0.002	0.88

Legend: RLEepEx = Running long jump (coach's assessment); MoepEx = Long throw of the oina ball (140 g) (coach's assessment).

The Wilcoxon test highlighted statistically significant differences between participants and a large effect size.

Regarding the long jump test, there was a statistically significant difference (Z = 2.969, p = 0.003) between the initial assessment (median = 21.57) and the final assessment (median = 27.33). The effect size index was r = 0.85, meaning a large effect of the experimental intervention on athletes' performance.

In the oina ball throw test, a statistically significant difference (Z = 3.069, p = 0.002) was emphasised between the initial assessment (median = 16.83) and the final assessment (median = 26.66). The effect size index was r = 0.88, meaning a large effect of the experimental intervention on athletes' performance.

Discussion and Conclusion

The research highlights that the use of audio-video technology in the training process of girl athletes aged 9-10 years contributes to a more correct execution of the technical moments included in the rating scales. Assessing the overall movement and the six moments by watching the videos recorded for each participant led to awareness of correct actions and improved results. This aspect demonstrates the effectiveness of combining the training plan developed and applied throughout the research with audio-video technology. Watching the technical execution and the performance achieved is a way of directly building the mental representations of children, which is also emphasised in the literature (Schack & Ritter, 2013; Beilock et al., 2002; Raab & Johnson, 2007; Land et al., 2014). Suchman (1987) also belives that new computing technologies enhance an individual's potential by developing their ability to react in a logical and abstract world and thus understand a wider and deeper range of problems. The above author suggests that the use of modern technology in the training process is based on the formation of perception, representation and memorisation of information, which directly and effectively contributes to accelerating the learning process, structuring the time allocated to improvement and objectifying scientific research investigations. Moreover, specialists are constantly interested in improving the behavior and performance of athletes (Pelin et al., 2018).

To achieve sports performance (which can be improved over time), children need to form a correct representation and understanding of movements. Visualisation combined with relaxation and video analysis helps children learn movements more easily and quickly (Predoiu et al., 2020). According to Schack et al. (2014), "skillfull coordination occurs if appropriate mental representations of the motor task and action goals are constructed, because cognitive representations govern the tuning of motor commands and muscular

activity patterns" (p. 1). This can be done by implementing audio-video technology in the athletic training of children (Sigrist et al., 2013; Pizzera & Hohmann, 2015; Sors et al., 2015).

By using audio-video technology in the training process, an improvement in sports performance was achieved in terms of technical execution and sports results. The findings of our research correspond to the opinion of Boyer et al. (2009), who state that video feedback leads to improved performance in a wide range of sports such as gymnastics (Wolko et al., 1993), basketball (Harle & Vickers, 2001; Vickers et al., 2017) or football (Smith & Ward, 2006). In our case, significantly better results were obtained in the final test compared to the initial test for the two analysed events (running long jump and oina ball throw).

In the present research, significant correlations were found between the points awarded for the execution of moments provided in the rating scales and the total number of points, the athletes' performance and the number of hours allocated to watching their own execution.

The "very good" rating obtained for all six moments of the running long jump included in the rating scale (with percentages between 33.33% and 91.67%) but also of the oina ball throw (with percentages between 50.00% and 91.67%) points out the positive influence of using audio-video technology in sports training.

Statistical analysis reveals significant differences between the initial and final assessments for both the running long jump and oina ball throw.

The use of audio-video technology during training for the appropriateness of feedback resulting from video recordings is supported by Wellner et al. (2008), who suggest that auditory and visual feedback contributes to achieving better performance. Therefore, the implementation of audio-video technology is nowadays an imminent necessity for any sports coach and athlete who aim to achieve sports performance.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the National University of Physical Education and Sports in Bucharest, Romania (ID:674).

Informed Consent Statement: The participants provided their written informed consent to participate in this study.

Data Availability Statement: Data are available upon request to the contact author.

Conflicts of Interest: The authors declare no conflict of interest.

References

Baiqi, N. (2022). Design of sports training improvement and evaluation method under the background of big data. *Advances in Multimedia, 2022*: 5651772. https://doi.org/10.1155/2022/5651772

Bădescu, D., Zaharie, N., Stoian, I., Bădescu, M., & Stanciu, C. (2022). A narrative review of the link between sport and technology. *Sustainability, 14*(23): 16265. https://doi.org/10.3390/su142316265

Beilock, S. L., Wierenga, S. A., & Carr, T. H. (2002). Expertise, attention, and memory in sensorimotor skill execution: Impact of novel task constraints on dual-task performance and episodic memory. *Quarterly Journal of Experimental Psychology, 55*(4), 1211-1240. https://doi.org/10.1080/02724980244000170

Boyer, E., Miltenberger, R. G., Batsche, C., & Fogel, V. (2009). Video modeling by experts with video feedback to enhance gymnastics skills. *Journal of Applied Behavior Analysis, 42*(4), 855-860. https://doi.org/10.1901/jaba.2009.42-855

Brazo-Sayavera, J., Martínez-Valencia, M. A., Müller, L., Andronikos, G., & Martindale, R. J. J. (2017). Identifying talented track and field athletes: The impact of relative age effect on selection to the Spanish National Athletics Federation training camps. *Journal of Sports Sciences, 22*(35), 2172-2178. https://doi.org/10.1080/02640414.2016.1260151

Bruton, A. M., & Wright, D. J. (2022). Watch and learn: Athletes can improve by observing the actions of others. *Frontieres for Young Minds, 10*: 702784, 1-7. http://dx.doi.org/10.3389/frym.2022.702784

Čoh, M., Jovanović-Golubović, D., & Bratic, M. (2004). Motor learning in sport. *Facta Universitatis Series: Physical Education and Sport, 2*(1), 45-59.

Dragnea, A., & Bota, A. (1999). *Teoria activităților motrice* [Theory of motor activities]. Editura Didactică și Pedagogică R.A.

Fishman, B., & Dede, C. (2016). Teaching and technology: New tools for new times. In D. H. Gitomer & C. A. Bell (Eds.), *Handbook of research on teaching* (pp. 1269-1334). American Educational Research Association.

Harle, S. K., & Vickers, J. N. (2001). Training quiet eye improves accuracy in the basketball free throw. *The Sport Psychologist, 15*(3), 289-305. https://doi.org/10.1123/tsp.15.3.289

Harris, M., Casey, L. B., Meindl, J. N., Powell, D., Hunter, W. C., & Delgado, D. (2020). Using behavioral skills training with video feedback to prevent risk of injury in youth female soccer athletes. *Behavior Analysis in Practice, 13*(4), 811-819. https://doi.org/10.1007/s40617-020-00473-4

Land, W. M., Frank, C., & Schack, T. (2014). The influence of attentional focus on the development of skill representation in a complex action. *Psychology of Sport and Exercise, 15*(1), 30-38. https://doi.org/10.1016/j.psychsport.2013.09.006

Land, W. M., Volchenkov, D., Bläsing B. E., Schack, T. (2013). From action representation to action execution: Exploring the links between cognitive and biomechanical levels of motor control. *Frontiers in Computational Neuroscience, 7*: 127. PMID: 24065915

Malina, R. M. (2010). Early sport specialization: Roots, effectiveness, risks. *Current Sports Medicine Reports, 9*(6), 364-371. https://doi.org/10.1249/jsr.0b013e3181fe3166

Pelin, F., Predoiu, R., Mitrache, G., Predoiu, A., & Grigore, V. (2018). Generation of efficient behaviours in the case of performance athletes. *Discobolul – Physical Education, Sport and Kinetotherapy Journal, 53*(3), 31-38.

Pizzera, A., & Hohmann, T. (2015). Acoustic information during motor control and action perception: A review. *The Open Psychology Journal, 8*(1), 183-191. http://dx.doi.org/10.2174/1874350101508010183

Predoiu, R. Predoiu, A., Mitrache, G., Firănescu, M., Cosma, G., Dinuţă, G., & Bucuroiu, A. (2020). Visualisation techniques in sport - the mental road map for success. *Discobolul – Physical Education, Sport and Kinetotherapy Journal, 59*(3), 245-256. https://doi.org/10.35189/dpeskj.2020.59.3.4

Raab, M., & Johnson, J. G. (2007). Expertise-based differences in search and option-generation strategies. *Journal of Experimental Psychology: Applied, 13*(3), 158-170. http://dx.doi.org/10.2174/1874350101508010183

Schack, T., & Ritter, H. (2013). Representation and learning in motor action: Bridges between experimental research and cognitive robotics. *New Ideas in Psychology, 31*(3), 258-269. https://doi.org/10.1016/j.newideapsych.2013.04.003

Schack, T., Essig, K., Frank, C., & Koester, D. (2014). Mental representation and motor imagery training. *Frontiers in Human Neuroscience, 8:* 328. https://doi.org/10.3389/fnhum.2014.00328

Sigrist, R., Rauter, G., Riener, R., & Wolf, P. (2013). Augmented visual, auditory, haptic, and multimodal feedback in motor learning: A review. *Psychonomic Bulletin Review, 20*, 21-53. https://doi.org/10.3758/s13423-012-0333-8

Smith, S. L., & Ward, P. (2006). Behavioral interventions to improve performance in collegiate football. *Journal of Applied Behavior Analysis, 39*(3), 385-391. https://doi.org/10.1901/jaba.2006.5-06

Sors, F., Murgia, M., Santoro, I., & Agostini, T. (2015). Audio-based interventions in sport. *The Open Psychology Journal, 8*(Suppl 3: M6), 212-219. http://dx.doi.org/10.2174/1874350101508010212

Suchman, L. (1987). *Plans and situated actions: The problem of human-machine communication*. Cambridge University Press.

Stoica, M. (2000). *Capacităţile motrice în atletism* [Motor skills in athletics]. Printech.

Ursanu, G., Budevici, A., & Ursanu, V. (2008). *Modelarea şi algoritmizarea managerială a antrenamentului sportiv la grupele de începători şi avansaţi în atletism* [Modelling and managerial algorithmization of sports training for beginner and advanced groups in athletics]. Casa Editorială Demiurg.

Vaeyens, R., Lenoir, M., Williams, A. M., & Philippaerts, R. M. (2008). Talent identification and development programmes in sport: Current models and future directions. *Sports Medicine, 38*(9), 703-714. https://doi.org/10.2165/00007256-200838090-00001

Vickers, J. N., Vandervies, B., Kohut, C., & Ryley, B. (2017). Quiet eye training improves accuracy in basketball field goal shooting. *Progress in Brain Research, 234*, 1-12, https://doi.org/10.1016/bs.pbr.2017.06.011

Wellner, M., Schaufelberger, A., Zitzewitz, J., & Riener, R. (2008). Evaluation of visual and auditory feedback in virtual obstacle walking. *Presence: Teleoperators and Virtual Environments, 17*(5), 512-524. https://doi.org/10.1162/pres.17.5.512

Wolko, K., Hrycaiko, D., & Martin, C. (1993). A comparison of two self-management packages to standard coaching for improving practice performance of gymnasts. *Behavior Modification, 17*(2), 209-223. https://doi.org/10.1177/01454455930172007