Optimization of the process of improving the quality of execution of dynamic elements with turns with a hoop for female athletes of 11-12 years old in rhythmic gymnastics

Suprun Alexandra Alexandrovna
Candidate of Pedagogic Sciences, Associate Professor
Medvedeva Elena Nikolaevna
Doctor of Pedagogic Sciences, *Full Professor*
Fedorenko Yulia Valerievna
Bachelor
Getmanskaya Anastasia Dmitrievna
Bachelor
Lesgaft National State University of Physical Education, Sport and Health, St. Petersburg

Abstract. In the article, on the basis of a system analysis of the components of the technical skill of female athletes, which determine the orientation of mastering and high-quality execution of dynamic elements with rotation in rhythmic gymnastics, a technique for improving the throwing elements with a hoop, based on the development of speed, has been developed and tested, contributing to the optimization of the training process.

Keywords: rhythmic gymnastics, dynamic elements with rotation, throwing elements with a hoop, expert judgment, speed, performance technique.

Introduction

Rhythmic gymnastics as a sport is distinguished by the high importance of the accuracy of motor actions fulfillment when assessing the technical components of the athletes' competitive programs. The least reliable of the wide variety of technical elements with objects, according to experts, are throwing actions [2,4]. In this regard, close attention is paid to the issue of studying the technique of throwing actions in rhythmic gymnastics. The biomechanics of gymnastic exercises mainly requires a high level of special motor training from female athletes. It is the high indices of vestibular stability and quickness of reaction to a moving object when performing complex dynamic elements with rotation ("risks" R - according to the FIG code), the basis of which are throwing actions are the earnest of the success of competitive activity in this kind of sport. The complexity and responsibility for the error-free execution of complex coordination elements from the rhythmic gymnastics program, in particular dynamic elements with rotation, requires the improvement of the existing teaching methodology. In most of the works devoted to this problem, the authors stop at a qualitative description of the technique of movements from the standpoint of the methodological substantiation of the process of teaching throwing actions [1,3,5]. Meanwhile, as studies show, in rhythmic gymnastics there are no modern scientific and methodological developments on this issue, despite the fact that dynamic elements with rotation make up 30% of the total number of elements in the competitive compositions of athletes.

In this regard, the relevance of the research performed is determined by the importance of high-quality and reliable performance of dynamic elements with rotation in rhythmic gymnastics in

the conditions of progressive requirements for the performance skills of female athletes, as well as the need to use scientifically based approaches to the formation of basic skills in throwing actions with a hoop, ensuring the implementation of promising a prognostic approach in the development of elements of a given structural group.

Purpose of the study – to scientifically substantiate and develop a set of means aimed at improving the quality of dynamic elements with rotation, based on the development of indicators of speed in gymnasts of 11-12 years old in an exercise with a hoop in rhythmic gymnastics.

Materials and methods

In order to concretize the direction of pedagogical influences in the development of dynamic elements with rotation (throwing elements - "risks") in rhythmic gymnastics, studies were carried out, including: pedagogical observation, pedagogical testing, expert assessment, design, pedagogical experiment and mathematical and statistical processing of results.

Results and discussion

In the process of analyzing the competitive programs of 3 Olympic cycles from 2009-2012, 2013-2016 and from 2017-2021, quantitative and qualitative indicators were determined for dynamic elements with rotation in competitive compositions with a hoop (table 1, 2).

It was found that the most frequently used types of throw when performing dynamic elements with rotation at the 2012 Olympic Games were a throw in an inclined plane, a throw with a hoop rotating around its axis, as well as throws without visual control and without the help of hands (Table 1). The gymnasts did not use the underfoot/feet throw and the throw from the floor position. This is due to the fact that these variations of the throw are the most difficult to execute.

Analysis of the 2016 Olympics in Rio de Janeiro showed that most often gymnasts performed throws in an inclined plane, during rotation and equally throws without visual control and without the help of hands, while a throw from a position on the floor was also not has been applied.

Table 1 - Dynamics of quantitative indicators of the criteria for the work of the hoop when throwing on dynamic elements with rotation in rhythmic gymnastics in the process of the evolution of the sport (number, n = 24)

Criteria for the work of the hoop when throwing	Olympic cycle		
	2009-2012	2013-2016	2017-2021
	M±m	M±m	M±m
(without visual control)	0.50±0.12	0.88±0.09	1.25±0.11
(hands free)	0.50±0.11	0.88±0.09	1.20±0.01
(under a foot/feet)	0.00±0.00	0.04±0.02	0.21±0.08
(throw after bouncing off the floor/throw after rolling on the floor)	0.13±0.05	0.17±0.06	0.21±0.07
(from a position on the floor)	0.00±0.00	0.00±0.00	0.04±0.02
BD (body difficulty)	0.17±0.06	0.08±0.03	0.50±0.11
(during rotation)	0.33±0.09	0.88±0.11	1.41±0.15

(passage through the object)	0.04±0.02	0.08±0.03	0.04±0.02
(incline throw)	1.58±0.19	1.13±0.09	1.38±0.17
(spinning throw)	0.63±0.13	0.42±0.11	1.00±0.03
Throw after rotating the hoop on a part of the body	0.21±0.07	0.29±0.09	0.33±0.01

At the 2019 World Championships in Baku, the girls demonstrated the maximum possible number of throw varieties, as this was facilitated by the introduction of an open assessment in 2018. The most common among them were: throw during rotation, throw in an inclined plane, throw without visual control, throw without the help of hands, and gymnasts often combined these modifications of throws.

Over the course of 3 Olympic cycles, the number of throw criteria performed during dynamic elements with rotation has steadily increased. At the London Olympics, their total number was 82, in Rio de Janeiro - 116, and at the 2019 World Championships - 182. Thus, over 7 years, their number has grown by 2.2 times, which reflects a significant increase in the technical readiness of female gymnasts.

Analysis of the criteria for catching a hoop when performing dynamic elements with rotation at the London Olympic Games indicates that gymnasts mainly used catching during rotation, without using hands, in a position on the floor, direct repeated throw/bounce from different parts of the body or the floor, as well as catching without visual control (table 2). The girls did not catch under the foot/feet, and the roll catch was demonstrated only 3 times. At the 2016 Olympics, the most common criteria were: catching while spinning, in a position on the floor, without using the hands, without visual control. Catching with body difficulty (BD), as well as catching with direct re-throw/rebound from different parts of the body or the floor were not used. The 2019 World Championship in Baku was characterized by numerous criteria for catching in different performances.

Table 2 - Dynamics of quantitative indicators of the criteria for the work of the hoop when catching on a dynamic element with rotation in rhythmic gymnastics in the process of the evolution of the sport (number, n = 24)

Criteria for the work of the hoop when throwing	Olympic cycle		
	2009-2012	2013-2016	2017-2021
	M±m	M±m	M±m
(without visual control)	1.54±0.17	0.88±0.15	3.29±0.15
(hands free)	2.00±0.16	0.92±0.13	2.83±0.22
(during rotation)	2.08±0.17	1.92±0.14	2.96±0.17
(on the floor)	1.83±0.13	1.13±0.11	1.42±0.14
(under a foot/feet)	0.00±0.00	0.04±0.02	0.13±0.05
(direct re-throw/rebound from different parts of the body or the floor)	0.17±0.06	0.00±0.00	0.08±0.03

BD (body difficulty)	0.38±0.10	0.00±0.00	0.04±0.02
(passage through the object)	0.42±0.11	0.33±0.01	0.83±0.11
(roll catching)	0.13±0.05	0.08±0.03	0.25±0.08

So, catching was often demonstrated without visual control, during rotation, without using the hands, in a position on the floor, and in a passage through an object. More popular among gymnasts were catching in rotation, roll, under the leg/legs, direct repeated throw / rebound from different parts of the body or the floor, as well as catching, performed on body difficulties. Consequently, the 2019 World Championships demonstrated all possible variations of the catching criteria of an apparatus during a dynamic element with rotation.

The catching criteria and their combinations, performed at the World Championships in Baku, are superior in quantitative ratio to the two previous cycles: 292 to 212 and 133 respectively, which is directly related to the competition rules of the 2017-2021 Olympic cycle and the corresponding technical skill of female athletes. Based on the analysis, it follows that at the present stage of development of rhythmic gymnastics there is a tendency to an increase in the level of technical skill of female athletes.

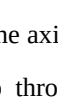
Taking into account that dynamic elements with rotation are rather complex movements in terms of biomechanical structure, increased requirements are imposed on gymnasts for physical fitness, in particular, for speed, ensuring the quality of their performance, in particular catching of the apparatus. In this regard, optimization of special physical training is one of the ways to improve the quality of throwing elements, for further complicating the work of the apparatus when performing dynamic elements. This was confirmed by the data of the performed correlation analysis (table 3, 4).

So, for example, in the course of the correlation analysis of the execution of a hoop with a foot on a forward coup while rolling the hoop on the floor at the moment of returning the hoop with a reverse cut, a relationship was revealed between the quality of its execution and the speed of reaction to a moving hoop (r=-0.6) (table 3). Accordingly, if an athlete performs an untimely leg swing to perform a forward flip throw, inaccurately brings her leg under the hoop - sooner or later after it returns, there is a possibility that the throw will not be executed due to the loss of the hoop.

Table 3 - Relationship between the quality of the hoop throw during the basic dynamic element with the rotation "hoop throw -2 rotations around its axis with over-catching the hoop" and speed indicators (n=12)

Control exercises	The technique of throwing during a dynamic element with rotation - 2 rotations around its axis
	Throw criteria

										BD	
Estimating the speed of a single movement											
Somersault forward	0.44	-0.09	0.05	0.08	0.36	0.05	-0.01	0.48	-0.03	-0.05	-0.32
Flip to the side	0.16	0.19	-0.21	0.45	-0.52	0.32	-0.01	0.09	0.23	0.68	0.29
"Compass"	0.05	0.10	0.17	0.44	-0.33	0.49	0.18	0.41	0.33	0.35	0.64
Flip forward	0.06	0.14	-0.26	0.43	-0.46	0.44	-0.05	0.48	0.37	0.41	-0.06
Flip back	0.09	0.23	0.14	-0.20	0.15	0.35	0.04	0.26	0.15	0.24	0.11
Motion frequency estimation											
Forward bends	0.04	0.04	-0.10	0.22	0.27	0.25	0.06	0.54	0.08	0.11	-0.36
Support crouch-emphasis lying	0.12	-0.06	0.35	0.23	0.33	0.21	0.03	-0.09	-0.20	-0.06	-0.32
Jumping with change of legs	0.20	-0.13	0.02	-0.58	0.45	-0.28	0.04	-0.38	-0.42	-0.22	-0.35
Raising legs to the side	0.19	0.03	0.11	0.19	0.33	-0.04	-0.25	0.21	0.05	-0.01	0.09
Jumping over a double-folded rope	-0.08	0.00	-0.26	0.42	-0.34	0.19	0.21	0.02	0.32	0.22	0
Evaluation of the speed of reaction											
"Touching the balls"	-0.26	0.01	-0.16	-0.21	-0.56	-0.24	-0.19	0.20	0.33	0.14	0.15

Note:  (Changing the axis of rotation of the body/changing the level during rotation: 2 rotations around its axis - vertical roll);  (hoop throw under the shoulder);  (backward swing of the hoop);  (hoop throw);  (throwing the hoop with a foot on a forward roll at the moment of returning the hoop with a reverse cut);  (Throw with a pass into the hoop on a jump with a backward rotation of the hoop);  (throw of the hoop in an inclined plane);  (throw with the rotation of the hoop around its axis);  (kneeling hoop); BD (throw of the hoop on a jump "tap and turn");  (Throw of the hoop with a leg on a coup forward with rotation of the hoop around its axis)

Secondly, the execution of this throw depends on the speed of the single movement (r=-0.6; r=-0.5). Thus, the slower the gymnast performs the pre-acrobatic element during the execution of the kick, the less time she will have to return to the starting position at the end of her execution for catching, which will lead to deductions from 0.5 to 1.0 points by the judges E3-E6 (a team of judges evaluating technical errors in execution) according to the rules of the sport. Thirdly, performing a dynamic element with rotation by throwing the hoop with a foot on a forward roll when rolling the hoop on the floor at the moment of returning the hoop with a reverse cut, it is necessary to take into account the frequency of movement (r = 0.5). If the gymnast performs rotational elements under the throw slowly, this can lead to errors in the base of the dynamic element with rotation - the absence of at least two rotations, as well as to technically incorrect catching or its absence.

In the course of establishing the relationship between the expert assessment of the execution of a dynamic element with rotation (throw of the hoop - 2 rotations around its axis - catching the hoop), complicated by various criteria of difficulty in catching, and indicators of speed, it was revealed that the most difficult performance for gymnasts is catching under the foot in a forward flip (r=0.7). Secondly, the execution of catching under the foot in a forward roll depends on

the rate of movement (r=0.6, r=0.5). Thus, the faster a gymnast performs rotational elements before catching, the more time she has to coordinate her actions and perform complex catching under the leg in a forward roll, respectively, this type of catching directly depends on the level of development of the athlete's movement frequency. Third, there is a relationship between reaction speed and catching underfoot in a forward roll (r=0.5). Accordingly, the lower the level of development of the speed of reaction in the gymnast, the greater the likelihood of an untimely performed rotational element when catching the hoop. Therefore, there is a possibility of an error and an unfulfilled catching due to the early landing of the hoop or an early attempt to perform a forward roll (table 4).

The established connections were taken into account when specifying the means and developing complexes of throwing elements with a hoop, aimed at improving the quality of the execution of dynamic elements based on the development of speed.

Their approbation was carried out in the process of a pedagogical experiment, during three months of a general preparatory mesocycle (from February to April 2021) on the basis of SKHG "Phoenix", St. Petersburg.

Table 4 - Relationship between the quality of the hoop catching performance during the basic dynamic element with the rotation "throw of the hoop -2 rotations around its axis with overstepping-catching the hoop" and speed indicators (n=12)

Control exercises	Technique of catching during a dynamic element with rotation - 2 rotations around its axis										
	Throw criteria										
								BD			
Estimating the speed of a single movement											
Somersault forward	0.38	0.06	0.22	-0.44	0.68	-0.19	0.45	-0.32	-0.16	-0.30	-0.27
Flip to the side	0.23	-0.01	-0.14	0.18	0.17	-0.01	0.07	0.12	0.06	-0.24	-0.22
"Compass"	0.08	0.09	-0.44	-0.25	0.13	0.31	-0.14	0.17	-0.08	-0.18	0.29
Flip forward	0.18	-0.18	-0.05	-0.35	0.23	0.01	0.31	0.01	0.10	0.03	-0.35
Flip back	-0.07	-0.05	0.18	0.03	0.14	0.26	0.22	0.21	0.4	0.18	0.13
Motion frequency estimation											
Forward bends	0.10	0.16	0.46	-0.19	0.62	-0.16	0.30	-0.03	0.463	0.36	-0.03
Support crouch-emphasis lying	0.09	0.56	0.36	0.25	0.51	-0.11	-0.04	0.10	0.20	0.12	0.28
Jumping with change of legs	-0.01	0.18	0.72	0.49	-0.03	-0.35	0.13	0.20	0.51	0.47	-0.01
Swing your leg forward into a split	0.19	0.40	0.19	0.03	-0.21	0.17	0.09	0.28	-0.15	0.32	0.31
Swing your leg back into a split	0.12	-0.12	0.09	0.01	-0.04	-0.14	-0.12	0.43	0.25	0.37	0.00
Evaluation of the speed of reaction											
"Touching the balls"	-0.28	-0.02	0.37	0.20	-0.50	0.09	0.62	-0.09	-0.05	0.30	-0.24
Notes:  (Changing the axis of rotation of the body/changing the level during rotation: 2 rotations around its axis - forward somersault);  (catching with hands passing into the hoop behind the head (right arm up, left arm back));											

 (catching hoop sitting in knees);  (catching the hoop with one hand in a back flip);  (catching the hoop under the leg in a forward flip with one hand);  (catching in bounce);  (catching the hoop while sitting with one hand); BD (catching the hoop on the balance "attitude");  (catching in the passage through the hoop on a jump with legs bent);  (catching the hoop in a roll on the arms and back, arms to the sides);  (catching the hoop in a spin on the shin).

16 female athletes aged 11-12 years old took part in the formative experiment. The gymnasts were divided into a control and an experimental group of 8 people. In the control group, training was carried out as usual, in the experimental group, developed complexes of means were used, aimed at improving the quality of the performance of dynamic elements with a hoop through the development of speed. The exercise complexes were used 3 times a week in the main part of the lesson for 20-30 minutes.

The developed complexes of means were grouped into 6 complexes for throwing a hoop and 7 complexes for catching a hoop, in accordance with the criteria being met: complex №. 1, aimed at improving the quality of fulfillment of the throw criterion "after rolling on the floor"; complex № 2, aimed at improving the quality of the fulfillment of the throw criterion "with the rotation of the hoop around its axis"; complex № 3, aimed at improving the quality of fulfillment of the "underfoot" throw criterion; complex № 4, aimed at improving the quality of the implementation of the complexity factor of the throw "on the jump"; complex № 5, aimed at improving the quality of the implementation of the factor of the complexity of the throw "during rotation"; complex № 6, aimed at improving the quality of the fulfillment of the throw criterion "pass through the hoop"; complex № 7, aimed at improving the quality of the catching criterion "under the foot"; complex № 8, aimed at improving the quality of the catching criterion "without the help of hands"; complex № 9, aimed at improving the quality of the catching complexity factor "on the floor"; complex № 10, aimed at improving the quality of the catching criterion "passing through the hoop"; complex № 11, aimed at improving the quality of the catching criterion "out of visual control"; complex № 12, aimed at improving the quality of the catching criterion "during rotation"; complex № 13, aimed at improving the quality of the catching criterion "with rolling the hoop over the body."

In both groups, there was a positive trend, but in the experimental group it was significantly higher. So, at the beginning of the pedagogical experiment, when performing dynamic elements by the subjects of both groups ($p>0.05$), average and gross errors were made (when throwing - an inaccurate trajectory, an incorrect plane, when catching - steps to the hoop, loss of an object) (Table 5). At the beginning of the experiment, the average score for the technique of performing dynamic elements with rotation with a hoop in competitive compositions among the

gymnasts of the control and experimental groups was practically the same: 0.34±0.02 points in the control group and 0.34±0.03 points in the experimental group. with an average penalty of 0.76±0.12 points in the control and 0.78±0.16 points in the experimental groups. Then at the end - in the experimental group, only some gymnasts made mistakes when performing throwing elements in competitive compositions.

Table 5- The results of an expert assessment of the implementation of dynamic elements with rotation (R) with a hoop in the process of a pedagogical experiment (n=16, points)

Criteria	At the beginning of the experiment; M±m			At the end of the experiment; M±m		
	EG	CG	P	EG	CG	P
R value	0,34±0,03	0,34±0,02	>0,05	0,52±0,02	0,34±0,02	<0,05
Penalty	0,78±0,16	0,76±0,12	>0,05	0,08±0,02	0,61±0,12	<0,05

After the pedagogical experiment, according to the results of the average score for the technique of performing dynamic elements with rotation in competitive compositions with a hoop, the gymnasts of the experimental group (EG) surpassed the gymnasts of the control group (CG) by 0.18 points (score CG 0.34 ± 0.02 points, EG 0.52±0.02 points) with a decrease in the average penalty by 0.53 points (score CG 0.61±0.12 points, EG 0.08±0.02 points). The pedagogical experiment showed that the developed complexes of means aimed at improving the quality of the fulfillment of dynamic elements with rotation in competitive compositions with a hoop by gymnasts of 11-12 years old in rhythmic gymnastics turned out to be effective.

Conclusion

Thus, approbation of the developed complex of means for improving the technique of dynamic elements with rotation in competitive compositions with a hoop, based on the development of speed indicators, confirmed its effectiveness. The effectiveness of turns fulfillment at the end of the forming experiment proved the possibility of directed stimulation of the growth of sportsmanship of female gymnasts, and the increase in the effectiveness of their competitive activity.

References

1. Agostini, P. B-R. Teaching throwing elements of increased difficulty in rhythmic gymnastics: diss. ... cand. ped. sci. Moscow, 2017. – P.54-53.
2. Andreeva, N.O. The value of individual components of the subject training of gymnasts

according to the questionnaire survey of coaches of different qualifications / N.O. Andreeva // Pedagogy, psychology and medico-biological problems of physical education and sports. – 2014. – № 9. – P. 3-10.

3. Individual biomechanical features of the interaction of athletes with objects in rhythmic gymnastics / V.M. Adashevsky [et al.] // Pedagogy, psychology and medico-biological problems of physical education and sports. – 2014. – № 6. – P. 3-10.
4. Konovalova, L.A. Biomechanical structure of throwing actions in rhythmic gymnastics / L.A. Konovalova, V.B. Pokaninov // Scientific notes of the Lesgaft National State University of Physical Education, Sport and Health. – 2017. – № 2 (144). – P. 101-106.
5. Konovalova, L.A. Means and methods of training the accuracy of motor actions in rhythmic gymnastics: author. diss. … cand. ped. sci. / Konovalova L.A. – SPb., 1993. – 21 P.