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Experimental Study of Efficiency of Technical and Tactical Actions in Billiard Sport

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Abstract The purpose of the article was the efficiency of the authors' methodology for improving the technique and activity of billiard players. The following methods were used: observation of training and competitive play activity of highly qualified billiard players, a computer technique for registering technical and tactical actions. The methodological aspects of physical training, determined by technical and tactical improvement in billiard sports, are revealed. To conduct the experiment, the experimental and control groups were formed, which included 14 highly qualified billiard players, equal in terms of sports mastery and representing the group of elite athletes of Kazakhstan. The methodology's efficiency was revealed by applying a computer technique for registering technical and tactical actions developed using the Excel program, which is intended for the primary mathematical and statistical analysis of the shots included in the methodology. In the course of the experiment, along with the most significant technical and tactical actions, the most rarely used shots were also revealed: cut double, croiset-revolving, jump shot, and tactical aspects of their implementation in game competitive activity. The use of the author's methodology for improving the technical and tactical actions of highly qualified billiard players in the experiment showed a significant improvement in the efficiency of the technical and tactical actions of the experimental group and drove up the level of sports mastery of highly qualified billiard players. The quantitative differences (in percent) when using different types of shots are presented.

Keywords Billiard Player, Technical and Tactical Actions, Formative Experiment, The Efficiency of Shots, Methodology, Experimental and Control Groups

1. Introduction

In foreign scientific sources, as opposed to domestic, the concept of billiard is considered in two aspects: on the one hand, billiard is an entertaining game for recreation, and on the other hand, it is a kind of sport that requires significant physical vigor, and often maximum mental strain [1,2]. Understanding the differences between game and sport can be achieved if we can identify these two terms as two different words. Sport is the physical activity carried out according to a fixed set of rules, with competition, self-fulfillment, or a combination of both. A game is an entertaining activity with the participation of one or more players, defined by the goal that players try to achieve, and a set of rules to play it [3]. This aspect of billiard was not considered by Kazakhstan sports science. Speaking of the entertainment side of billiard, it is necessary to note that in the USSR and Kazakhstan, it was an integral part of every

rural club or cultural center where the local electorate spent free time.

As a sport, billiards began to develop actively in Kazakhstan at the beginning of the 1990s of 20th century, when billiard clubs began to be formed, a federation was established which began to hold domestic and then international competitions. Among the most significant scientific and pedagogical problems of billiard, the greatest significance is the training of a billiard player, primarily technical and tactical. In this case, in accordance with the views of the methodologists of athletes and researchers, technical actions are defined as sequences of physical movements of an athlete specific for this sport. Tactical actions are defined as sequences of applying technical actions in relation to the actions of a partner in the game to achieve victory [4,5]. Moreover, if we are talking about highly qualified billiard players, then it is customary to talk about technical and tactical training. The problem of physical fitness is being raised to a lesser extent. Strictly speaking, the activity of a billiard player, unlike other sports, does not claim excessive demands on physical fitness, therefore, the main part of the training process is the improvement of technical and tactical actions. In the training process, physical fitness is considered in the context of technical and tactical training.

It should be noted that technical and tactical training takes place on the basis of an individual plan and each billiard player determines for himself the approaches and content of technical and tactical training, intuitively adapting it to his or her characteristics, without taking into account any objective law. As a result, there are a large number of poorly systematized training options and methods of their application. For example, some authors consider that it is possible to master the technique and tactics of billiards in 70 hours [4], others confirm that in order to master a given shot it is necessary to have at least 200 raps in one training [6], still others say: that it takes 9 to 15 years to train a qualified billiard player [7]. A completely special approach to mastering the secrets of the billiard game can be seen in the book by G.G. Koriolis [8], where the technique and tactics of the game are considered through the prism of mathematical theory. V.V. Lazarev [9] recommends a two-hour training volume for those players who train professionally and, if necessary, this time can be increased to four hours. In his opinion, this technique will allow achieving a high training level and mastery.

There are also studies related to mastering the technique of billiards in English language scientific publications. So 7 basic rules of mastering the billiard technique are described in work [10], according to the authors, (grip of the cue stick, correct stance for shot, alignment of the body in the direction of the target ball, in which the hand, eyes, head, and cue stick are in a straight line, training in swinging the pendulum, in which a part of the arm below the elbow performs pendulum movements forward and backward, the choice of the type of bridge for directed support of the cue stick and its training, the development of an individual program for the execution of the shot). J. Side [11] also offers the possibility of training billiards without a billiard table, using the technique of training with a bottle, with a mirror, or a phone camera. Ralph Eckert [12] proposes a methodology for teaching the technique and tactics of the game with the help of illustrations and photographs, considering it quite effective, especially at the early stage.

The development of digital technologies and, in particular, computer modeling prompted researchers to use computer technologies to increase the efficiency of the choice of tactical decisions in billiards when determining the option of shot. Research materials on the development of a virtual assistant for billiards are given in the master's thesis [13]. The purpose of this project was to explore the possibilities of the virtual billiards assistant (VBA), which should help players who want to master the game, and, eventually, replace the human billiards coach. The best solution of the virtual assistant is considered to coincide with the decision of the coach-expert. The advantage of a virtual assistant is that the player does not have a dilemma when he does not know what to do in the current game situation on the billiard table. The necessity of mandatory use of an experienced instructor for training and mastering billiards is stated in the research [12]. Individual study in the technique and tactics of the game is less effective than with an instructor.

The possibilities of using computer video players to improve the technical and tactical skills of playing billiard players are discussed in the articles [3,14-16]. The review shows a variety of methods and approaches to technical and tactical training of billiards and to demonstrating their versatility. There is a tendency in English language publications to use digital technologies in the training process, i.e., the use of computer robots to improve the quality of technical training in billiard sports, which does not always guarantee its reliable improvement [17].

It should also be noted that almost all of these techniques are focused on the formation of billiards techniques and related to the improvement of tactics to a very small extent. Therefore, in order to improve the technical and tactical mastery of highly qualified billiard players, when almost one hundred percent efficiency of shots is achieved in the training process, the use of these techniques will be ineffective.

The analysis of the training activity of Kazakhstan billiard players showed that the improvement of the efficiency of technical and tactical actions can be achieved due to a high level of organization of the work-out session and the use of new training methods, based on an intensity increase and volume of training means, which are used in their practice by the strongest billiard players of our republic included in the global elite in some types of billiard sports. The generalization of these methodological techniques and the use of new principles and approaches to the workout session allowed us to develop an original training methodology, which contributes to an increase in

sports mastery of highly qualified billiard players and an increase in the efficiency of competitive activity on this basis. The constitutive essence of the methodology lies in the fact that it is aimed at the maximum possible simulation of various game situations in training conditions with their repeated practice. The content of the methodology is presented in the article [18].

In this regard, the purpose of the research is the experimental validation of the efficiency of the developed author's methodology for improving the technical and tactical training of highly qualified billiard players.

The main task of the research was to conduct a natural forming experiment, where the experimental groups and control groups were compared, the first group trained, applying the author's methodology in the process of improving the technical and tactical skills, and the second one worked according to the methodology generally accepted in the post-Soviet space.

2. Materials and Methods

To conduct an experimental research and generalize its results, the methods of scientific and theoretical analysis to study the organization of training and improve the efficiency of technical and tactical activity in billiard sports were used in the work, observe the training and competitive activity of highly qualified billiard players, a pedagogical formative experiment using the author's methodology aimed at increasing efficiency and efficiency of technical and tactical activities, a computer technique designed to register the efficiency of technical and tactical actions and presented in the journal "Theory and methodology of physical education", which is a peer-reviewed publication of the Committee for Control of the Ministry of Education and Science of the Republic of Kazakhstan [5], methods of mathematical statistics: calculating the arithmetic mean indicators of impacts included in the method ($\overline{X}$), standard deviation (σ) for comparing statistical analysis, Student-*t*-test of difference (t), confidence level (P) [19].

To conduct a pedagogical experiment, two groups of highly qualified billiard players were formed: the experimental group (14 people) and the control group (14 people). Highly qualified billiard players included players with an athletic title not lower than Candidate Master of Sports (CMS) - 1 person and sports titles: Master of Sports (MS) - 18 people, Master of Sports of International level (MSIL) - 7 people, and Honored Master of Sports (HMS) - 2 people. Both groups were selected in such a way that the age of the participants ranged from 26 to 36 years and each of the groups included 10 men and 4 women. Since the selection of participants was carried out at random, this ratio may reflect the ratio of age and gender for the general population of Kazakh billiard players with the appropriate rank. All billiard players participate in the championships of the Republic of Kazakhstan, Asia, Europe, and the world and the largest international, including prestigious traditional tournaments, where athletes are invited who are included in the first hundreds of the ranking in the free and dynamic pyramids. Many of them are champions and medal winners of these tournaments. Honored Masters of Sports have become world champions in free and dynamic pyramids at least twice.

All the exercises and tasks included in the methodology were presented and explained to all the participants in the experimental group in detail, conditions, and the sequence of their implementation for the entire period of the experiment, which took place during one sports season from January to December 2020.

Before the start of the experiment, technical and tactical indicators of the efficiency of all shots were taken (direct shot, cut shot, right side, left side, top right side or the right follow shot, top left side or the left follow shot, lower right side or the right draw shot, lower left side or the left draw shot, follow shot, draw shot, klapstos, double, cut double, croiset-revolving, jump shot), included in the computer technique, which served as background data.

To determine the indicators of the optimal implementation of technical and tactical actions, a group of 36 masters with the rank of Honored Master of Sports (HMS) and more than 10 years of successful performances in international competitions was selected. They were asked to define indicators of the optimal performance of each technical and tactical action, including all parameters of physical movement, position, force and direction of the blow, and any other parameters that they determine were critical for the execution of this action. In the course of three consecutive sessions of discussion on the Delphi methods, the proposals of the participants were consolidated until there was full agreement on the indicators by which the actions of the participants in the experiment were to be evaluated in the future. The reliability of the method for determining indicators was tested by the Cronbach Alfa method according to the results of the first test of the participants in the experiment and showed α = .761. The expert validity of the method is ensured by the Delphi method when it is created.

During the tests, video recordings of the performance of the participants were carefully studied by 8 judges from the composition of those who determined the indicators and, based on reaching a general consensus and comparison with the optimal performance recorded on video previously performed by world famous masters, judgment and evaluation were made in accordance with the method described earlier [9].

After completion of the experiment, the same indicators were re-measured. All billiard players in the experimental and control groups trained in their clubs independently from one another, but the billiard players who were engaged in the experimental program nearly always could get advice via mobile communications if there were any difficulties in applying the methodology during the training process.

All billiard players in the experimental and control

groups gave their endorsement to participate in the experiment, provided that the obtained data on the technical and tactical efficiency will be used for scientific purposes.

3. Results

The efficiency of the developed methodology was tested during the formative pedagogical experiment. Technical actions serve as methodology indicators because they can be objectively counted and measured. However, the frequency and variability in the use of these techniques is a tactical element; the use of certain techniques in response to the actions of the partner are also a tactical element. Therefore, in the course of the analysis, it is necessary to talk about technical and tactical actions, since they are actually inseparable from each other in real practice. The results obtained using a computer technique for recording the efficiency of technical and tactical actions were distributed respectively among the experimental and control groups and their statistical comparative analysis was carried out using the Student's *t*-test. This test, along with the similar F-test (F), is the strictest and used to identify comparative differences between data from different equal-sized samples. The data obtained before the start of the experiment are presented in Table 1. As follows from the available average indicators, there are no differences between the control and experimental groups for any of the types of shots.

It is evidence that both groups showed equivalent results, which speak of the same level of sports mastery. It should be noted that the control group had some advantages in an average performance in a number of the applied shots. In particular, on “direct and cut shots”, “top and lower right sides”, “top and lower left sides”, “draw shot” and “jump shot”. However, the existing superiority is unreliable, despite the higher percentage of performance. In all cases, the t-test values are below the required significance level. This also applies to those performance indicators where the experimental group is superior to the control group.

It should be said that the indicators of technical and tactical actions (shots) have different average percentage performance. Of the total number of performed shots, the most often, more than third, billiard players performed cut shots. In the experimental group (EG) - 37%, in the control group (CG) - 37.4%. Further, in order of decrease, direct shots are in second place (EG - 11.6% and CG - 11.9%), in third place is the left side (EG - 9.3% and CG - 8.66%) and in fourth place is the right side (EG - 8.1% and CG - 7.74%). “Cut double”, “croiset-revolving” and “jump shot” were used more rarely, for which statistical differences were not calculated due to extremely low-performance values (in fact, it was an isolated phenomenon). We can say that from the point of view of statistics, the performance of these shots practically did not have any effect on the overall result of the game. Moreover, at the end of a game or a match, the performance of such technically complex and difficult to predict shots from the point of view of performance (hitting the ball into a pocket) by billiard players was practically excluded.

Table 1. Differences in the performance indicators of the experimental and control groups before the experiment, $n' = n_1 + n_2 - 2 = 26$

Methodology indicators	Experimental group		Control group		*t*	P
	$\overline{X}$	S_x	$\overline{X}$	S_x		
Direct shot %	11,6	1,41	11,9	3,37	0,309	-
Cut shot %	37,0	2,54	37,4	3,11	0,374	-
Right side %	8,10	2,93	7,74	2,77	0,333	-
Left side %	9,30	0,82	8,66	0,81	2,00	-
Top right side or the right follow shot, %	7,50	2,82	7,70	2,77	0,190	-
Top left side or the left follow shot %	7,90	2,28	7,30	2,76	0,625	-
Lower right side or the right draw shot %	1,60	0,33	1,89	0,45	1,933	-
Lower left side or the left draw shot %	2,10	0,58	2,12	0,46	0,100	-
Follow shot %	4,90	0,62	4,70	0,53	0,909	-
Draw shot %	5,10	0,69	5,57	0,61	1,958	-
Klapstos %	2,80	0,43	2,66	0,47	0,824	-
Double %	0,10	0,06	0,08	0,03	1,000	-
Cut double %	0,06	0,02	0,06	0,01	0	-
Croiset-revolving %	0,06	0,01	0,04	0,01	-	-
Jump shot %	0,03	0,009	0,04	0,008	-	-

The experiment was carried out in accordance with the developed plan for the application of the methodology developed by us in full and taking into account all methodological recommendations. After its completion, the same average performance indicators of technical and tactical actions as before the experiment were re-recorded during the competition. They are shown in Table 2 according to Student's t-test and confidence level statistics.

As follows from the presented indicators, significant changes have occurred during the experiment. The experimental group significantly out landed the control group in nine types of shots: direct shot (t = 3,529; P < 0,01), cut shot (t = 2,956; P < 0,01), right side (t = 2,184; P < 0,05), left side (t = 2,971; P < 0,01), lower right side or the right draw shot (t = 3,333; P < 0,01), lower left side or the left draw shot (t = 6,250; P < 0,001), follow shot (t = 9.882; P < 0,001), draw shot (t = 7,894; P < 0,001), double (t = 2,5; P < 0,05). For two types of shots, the indicators of the experimental group also out landed the control group, but the t-test does not reach the required level of significance, which indicates that there are no differences in the performance of the groups for these types of shots. Only in one type of shots, the control group was more effective than the experimental one. This is when performing klapstos, which ranks eleventh in the ranking of the most significant shots (t = 4,0; P < 0,01). For "cut double", "croiset-revolving" and "jump shot", as before the beginning of the experiment, the identification of statistical difference was not carried out due to its inexpediency, since even visible changes are almost hardly noticeable. These changes can be seen more clearly in Figure 1.

Table 2. Differences in the performance indicators of the experimental and control groups after the experiment, $n' = n_1 + n_2 - 2 = 26$

Methodology indicators	Experimental group		Control group		t	P
	$\overline{X}$	S_x	$\overline{X}$	S_x		
Direct shot %	13,3	1,42	10,9	2,13	3,529	0,01
Cut shot %	41,0	2,65	37,6	3,40	2,956	0,01
Right side %	6,30	1,34	5,23	1,23	2,184	0,05
Left side %	8,70	0,83	7,66	1,01	2,971	0,01
Top right side or the right follow shot, %	8,70	2,84	7,72	1,35	1,042	-
Top left side or the left follow shot %	9,32	1,94	8,28	2,06	1,386	-
Lower right side or the right draw shot %	1,41	0,24	1,01	0,40	3,333	0,01
Lower left side or the left draw shot %	3,17	0,63	1,92	0,37	6,250	0,001
Follow shot %	5,84	0,53	4,16	0,34	9,882	0,001
Draw shot %	6,33	0,67	4,83	0,30	7,894	0,001
Klapstos %	1,70	0,11	2,66	0,23	4,0	0,001
Double %	0,13	0,02	0,08	0,009	2,5	0,05
Cut double %	0,04	0,001	0,06	0,003	-	-
Croiset-revolving %	0,03	0,002	0,04	0,003	-	-
Jump shot %	0,02	0,002	0,04	0,002	-	-

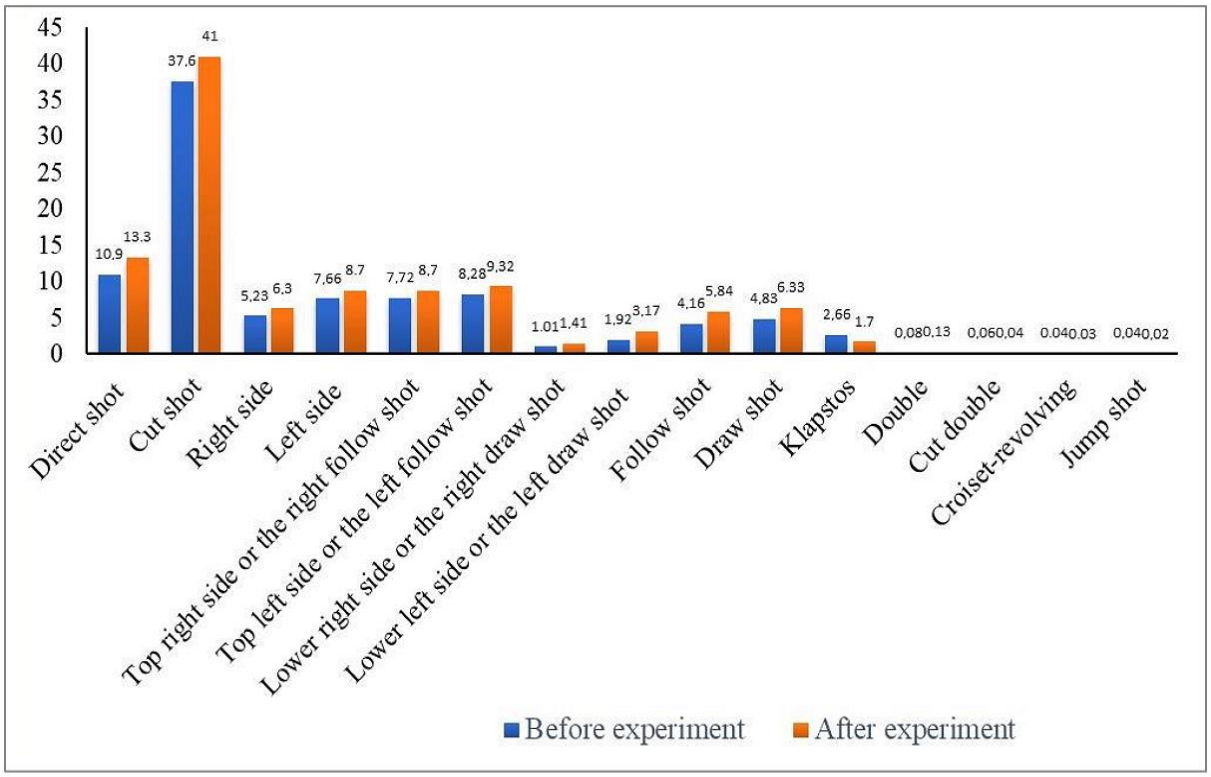

Figure 1. Indicators of the performance of technical and tactical actions of the experimental and control groups after the experiment

The obtained data on the superiority in the performance of the technical and tactical actions of the experimental group over the control group in accordance with the requirements of mathematical statistics is not yet sufficient evidence to speak of the higher efficiency of the methodology developed by us. To do this, it is necessary to compare the performance indicators of the experimental group before and after the experiment. A significant increase in the performance indicators of the experimental group after the experiment will be the most important evidence of the efficiency of the methodology, provided that these indicators also exceed the performance of the control group after the experiment. Our statistical analysis of the average performance values with the identification of the *t*-distribution of the data presented in Table 3 shows that after the experiment, the experimental group significantly out-landed the initial indicators for seven types of shots: direct shot (t = 3,036; P < 0,01), cut shot (t = 4,081; P < 0,001), top left side or the left follow shot (t = 2,290; P < 0,05), lower left side or the left draw shot (t = 4,458; P < 0,001), follow shot (t = 4,272; P < 0,001), draw shot (t = 5,125; P < 0,001), klapstos (t = 7,857; P < 0,001). For two types of shots, the average indicators after the experiment turned out to be lower (left side and top left side or the left follow shot), but the decrease did not reach the required level of significance, and for two more types of shots (top right side or the right follow shot and klapstos) they were large but also did not reach the required level of confidence (t = 1,132; P > 0,05 and t = 0,667; P > 0,05). In fact, it means that there are no differences in the performance of the four indicated shots, and at the statistical level, it has remained the same. As for the cut double, croiset-revolving, and jump shot, here the situation has not changed and the calculation of the Student's t-test was also devoid of practical sense. In addition, it should be borne in mind that a significant advantage was demonstrated by the shots most often used by billiard players.

Thus, the results of statistical analysis using the *t*-distribution (calculating the Student's *t*-test) give every reason to say that the increase in the efficiency of the shots performed by the experimental group is reliably associated with the use during the experiment of the method we developed, aimed at improving the performance of technical - tactical actions of highly qualified billiard players.

Table 3. Differences in the performance indicators of the experimental group before and after the experiment, $n' = n_1 + n_2 - 2 = 26$

Methodology indicators	Before experiment		After experiment		*t*	P
	$\overline{X}$	S_x	$\overline{X}$	S_x		
Direct shot %	11,6	1,41	13,3	1,55	3,036	0,01
Cut shot %	37,0	2,54	41,0	2,65	4,081	0,001
Right side %	8,10	2,93	6,30	1,34	2,093	0,05
Left side %	9,30	0,82	8,70	0,83	1,875	-
Top right side or the right follow shot, %	7,50	2,84	8,70	2,84	1,132	-
Top left side or the left follow shot %	7,90	1,28	9,32	1,94	2,290	0,05
Lower right side or the right draw shot %	1,60	0,33	1,41	0,24	1,900	-
Lower left side or the left draw shot %	2,10	0,58	3,17	0,63	4,458	0,001
Follow shot %	4,90	0,62	5,84	0,53	4,272	0,001
Draw shot %	5,10	0,69	6,33	0,67	5,125	0,001
Klapstos %	2,80	0,43	1,70	0,41	7,857	0,001
Double %	0,10	0,06	0,12	0,07	0,667	-
Cut double %	0,06	0,02	0,04	0,005	-	-
Croiset-revolving %	0,06	0,01	0,03	0,008	-	-
Jump shot %	0,03	0,009	0,02	0,007	-	-

4. Discussion

Our observations on the activity of Kazakh billiard players show that in the training process they often do not find time for their physical improvement, relying on their natural physical potential. In spite of that, they have demonstrated a high level of achievement in the international arena. Such volatility may be fraught when the match lasts a long time and begins to suffer from fatigue, which affects not only the physical fitness and motor activity of the billiard player, but also the efficiency of his tactical and technical actions and, first of all, on the exactness of the performed shots. This is proved by the increase in the number of errors observed among highly qualified billiard players at the end of a long match or game day.

Despite the obvious correlation between physical and technical-tactical training, there are very few studies in the billiard scientific literature that address the scientific and methodological issues of physical training in conjunction with the process of technical and tactical improvement. In the study presented here, none of the participants explicitly used specialized physical training in their training, but all had prior physical training. This moment makes the question of the importance of the physical training of billiard players open. From foreign studies calls attention to itself the work [20], which considers the coordination abilities of billiard players as the main component of physical training. This is determined by the fact that, in the case of long-term physical activity, sensory-motor mechanisms that ensure coordination activity get tired. In the Russian curricula of children's sports schools in billiards, a section of physical training is provided. However, an analysis of the content of these programs shows that in essence these sections are almost no different, but in fact, they tend to the content of the process of technical and tactical training [21,22]. Pertinently, this resembles methodological recommendations in which there is no place for the concepts of "amount of load", "intensity," "orientation" and there is no even indicative quantitative and qualitative data, body reactions to loads, etc. Titovsky A.V. [23] generally proposes to consider billiard as an innovative means of the educational process in the discipline "Physical education".

On the other hand, the decrease in the amount of time for physical training observed in the training process, whether or not, leads to an increase in the amount of time for technical and tactical training, thereby increasing its quality [12]. However, increasing the time for technical and tactical training is not a guarantee of improving its performance and efficiency.

Summing up the results of the forming pedagogical experiment, it should be said that the use of the developed original methodology, built taking into account the high level of organization of the training process and the use of new methodological techniques due to an increase in the

intensity and volume of training facilities while improving technical and tactical actions, allow you to significantly improve the sports mastery of high-skill billiard players.

The advantage of the methodology we have developed is that:

- it can be used in the natural conditions of the training process without requiring any additional devices or special equipment, it is enough to have a standard billiard table, balls, and cue stick;
- performing exercises that make up the content of the methodology allows you to get as close as possible to the conditions of competitive gaming activity;
- the content of exercises and tasks simulates real game situations;
- it makes it possible to increase the intensity of training in the most common and typical game situations;
- the methodology allows us to work on improving such game parameters relevant for technical and tactical activities as stability and reliability of motor actions (shots). The more accurate pocket shots a player makes in a certain unit of time, the more stability and reliability the skill gains. The skill is also strengthened by an increase in the rate of fire of shots (an increase in the number of shots in the pocket per unit of time), provided that their accuracy is maintained.

Another advantage of the methodology is the possibility of conducting a statistical comparative analysis of the game of billiard players. Performance data can be obtained for each type of shot used by billiard players, and an assessment of the significance of each of them for the overall efficiency of gaming activities. Based on the frequency of application of specific types of shots and their performance, individual differences of the billiard player's playing style can be studied. The same data can be used to calculate a player's rating not only in the republic but also in case of recognition at the international level, to have a high-quality reliable rating of all the world's strongest players. The application of the methodology will contribute to the quality of the training process management, and, if necessary, serve as a criterion for selection for responsible international tournaments in the presence of competition. With sufficient accumulation of a mass of statistical data on various types of shots, it will be possible to draw up model characteristics of the efficiency of technical and tactical actions for various types of billiards.

From foreign studies, where the problem of increasing the efficiency of technical and tactical actions is considered, the work [24] is very relevant, in which a simulator model is considered capable of determining the complexity factor of a supposedly delivered shot. The authors of the study do not provide data on how the actions of the simulator are extrapolated to the actions of a real billiard player performing shots at the gaming table, whether there are reliable correlations in this case.

An important aspect of the improvement of technical and tactical training is presented in the study [2], which examines the gender specificities of decision making and the efficiency of tactical activity depending on the properties of the main nervous processes of various complexity and latent periods of simple and complex sensorimotor reactions. The relevant aspect of gender differences did not appear statistically significant in our study, but its significance may be more pronounced with a larger sample.

The assessment of experience in visual forecasting was considered in the work [10]. It has been found that during the experiment, professional experts rarely extrapolated the closed part of the ball's trajectory with their eyes during occlusion, a behavior that was widespread among newcomers. Rather, they selectively examined specific diagnostic points on the sides of the table along the visible trajectory of the ball in accordance with the formal metric system used by professional players to calculate the trajectory of the shot. Thus, the eye movements of experienced observers contained a clear sign of billiard experience and empirically documented the updating of the strategy in solving visual problems from dynamic analog modeling in images to more effective conceptual knowledge based on rules.

It is not difficult to notice the multidirectionality of our and foreign research in approaches to the methodological foundations of improving the efficiency of technical and tactical actions of billiard players. Our approach is based on the desire for the most accurate modeling of the natural conditions of competitive activity, while most foreign researchers are aimed at using the capabilities of the computer modeling content of the billiard game. Further progress in the improvement of technical and tactical activities lies, in our opinion, in the integration of these two approaches and will largely be determined by the individual technical and tactical features of playing activities based on the psychophysical capabilities of billiards players.

5. Conclusions

1. There are two fairly clear methodological approaches to improving technical and tactical training in billiards sports: the first approach is based on modeling the natural conditions of competitive activity and is focused more on improving the tactical side of gaming activity, and the second is based on the principles of computer modeling and is more focused on improving billiards technology. When improving technical and tactical activities, the first approach is more preferable in the training of highly qualified billiard players, where tactics are more important for achieving high competitive results; less qualified players benefit from training with the use of computer technology, which allows them to quickly improve the technique of billiards.

2. At the present stage of the development of billiard sports, players pay relatively little attention to physical training, which is due to its lower significance compared to technical and tactical training, and prefer it to training aimed at technical and tactical improvement with extensive use of various aspects of playing activity.
3. Most often in their competitive practice, billiard players use a cut shot and direct shot, a right side and left side, as well as the right or left follow shot with top right or left side; players use a cut double, croiset-revolving and jump shot.
4. The results of a comparative analysis using the *t*-distribution (calculation of the Student's *t*-test) indicate that the increase in the efficiency of the shots performed by the experimental group in the process of competitive activity is reliably associated with the use of the methodology developed by us aimed at improving the efficiency of technical and tactical actions of highly qualified billiard players.

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