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RESEARCH ARTICLE

Developing Female Students' Motor Skills and Improving Basketball Playing Techniques by Means of Special Exercise Machines

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Abstract:

Introduction:

The article presents the technology of using technical equipment to develop the accuracy of ballistic movements, spatial-dynamic sensitivity during ballthrows and rebounds, as well as speed and strength qualities to improve jumping movements, implementation of fast breakthroughs, strong and long passes in basketball.

Methods:

The research involved 96 female students aged 17-23 years forming the experimental (EG, n = 54) and control (CG, n = 42) groups. The female students of EG played basketball in the conditions of group physical education training sessions using the exercise machines developed by us, and the female students of the CG were engaged in basketball playing according to the traditional program without the use of developed exercise machines and had an initial level of basketball technique. The EG was divided into EG1 (n = 37) and EG2 (n = 17) subgroups, which included female students having initial and high levels of basketball technique mastery, respectively. Female basketball players with an initial level of training (EG1 and CG) had experience of up to 3 years, athletes with a high level of training (EG2) - playing experience of more than 10 years. The technology of technical equipment application in basketball is built on the basis of the use of designed portable exercise machines to implement the tasks of motor and technical training of female basketball players of different levels of training.

Results

The results of the conducted experiment showed that the accuracy of throws from the average distance increased by 40.9% and 29.4% in the EG1 and EG2 female students, and it grew by 9.9% in the CG; from the long distance – by 61.5%, 37.0% and 31.3% respectively; the level of development of speed and strength qualities of female students of all groups improved i. e. the rate of growth in the results of the long jump made 9.7%, 3.2% and 6.5%, respectively; the rate of growth in the results of the high jump made 20.0%, 6.3% and 8.7%, respectively.

Conclusion:

Experimental testing of the technology of using designed exercise machines for the development of motor skills of female basketball students confirmed its effectiveness in terms of improving the spatial and dynamic accuracy of movement, speed and strength, as well as game performance of basketball players at competitions of various levels.

Keywords: Basketball, Female students, Technical equipment, Exercise machines, Accuracy of ballthrow, Speed, and strength quality.

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1. INTRODUCTION

The insufficient level of physical fitness and health of modern youth entering higher educational institutions and reduced interest of young people in physical education have made it necessary to increase the effectiveness of physical activities in higher educational institutions [1 - 3]. This requires finding new or improved traditional approaches to students' motor training [4 - 6]. The introduction of technical equipment into the educational process of physical education increases the developmental effect of exercise due to the possibility of a targeted impact on motor skills in conjunction with teaching techniques, accurate dosing of physical activity parameters and increasing motor density of training sessions [7 - 10]. At the same time, basketball is one of the effective types of health and fitness activities in higher educational institutions, which is characterized by high dynamism and emotionality, a large arsenal of motor actions, and variability of their application and accessibility for people of different levels of training and simplicity of conditions for both indoor and outdoor activities, and therefore, has the opportunity to solve educational, health and instructional problems of physical education of female students [11, 12].

According to many scientists [13 - 17], significant disadvantages of the modern system of physical education for female students are the conservative content, means, methods and standardized forms of exercise, low applicability and professional orientation, insufficient introduction of non-traditional means of motor activities, contemporary types of health and fitness activities, innovative sports technologies, and additional technical equipment for solving pedagogical tasks. Sports games are the optimal type of physical exercise, which is popular among young people, and has health, educational and applied value [18 - 20]. Basketball has a complex impact on the development of the individual and team, including motor, applied, volitional, moral, patriotic, and aesthetic aspects of life-sustaining and future professional activities of female students [21, 22]. Almost all the motor potential of the person is manifested in game activities, and basketball differs in a wide range of techniques and ways of use [23, 24]. The naturalness of movement, accessibility, wide range of actions, and the range of dosage and regulation of physical activity parameters stipulate a high variability of means and methods of physical quality development and increase the functional capabilities of female students [25, 26]. Along with the traditional approaches to the motor training of female students by means of basketball, mainly related to the use of exercises with the ball and their combinations through multirepeated approach or in-game conditions, there is the possibility to use supporting equipment during training sessions, including exercise machines and other accessories [27].

Recently, there has been a trend of the widespread introduction of technical devices in the practice of physical education of female students as a means of intensifying the educational process, physical development, and health improvement of female students, preparing them for future professional activities. Exercise machines are an additional tool that enhances the effectiveness of exercise [28, 29]. The expediency of using exercise machines in the process of sports games training is based on the ability to perform movements according to the specified parameters and structure under conditions of strict dosage of physical stress, which makes their use available for people of different sexes, ages and degree of training [30]. The experience has been gained at the present stage of the development of sports science in creating technical devices and exercise machines for teaching basketball. However, the pedagogical aspect, which includes the development and use of methods for the effective use of technical means of teaching basketball to female students with different levels of their training, remains underexplored.

1.1. Research Hypothesis

Based on the fact that training equipment has a positive effect on the development of motor skills in various sports, the use of specially designed exercise machines will promote the development of spatial-dynamic accuracy and speed-power qualities of female basketball players with the initial and high level of training, creating prospects for improving competitive game performance.

The aim of the research is to develop the technology involving technical equipment application for the development of the accuracy of movement during ball throw and rebound as well as speed and strength quality of female students with different levels of technical training in the process of basketball playing and check its effectiveness.

The following research tasks were set on the basis of the aim:

(1) To develop and substantiate portable training exercise machines for the implementation of tasks of motor and technical training of basketball players with different levels of technical training.

(2) To develop the technology involving technical equipment application for the development of accuracy of movement during ball throw and rebound as well as speed and strength quality of young people with different levels of technical training in the process of basketball playing.

2. MATERIALS AND METHODS

2.1. Participants

The research involved 96 female students aged 7-23 years of National Pedagogical Dragomanov University, who formed the experimental (EG) and control (CG) groups, including 54 and 42 female students, respectively. The experimental group of female students was divided into EG1 (n = 37) and EG2 (n = 17) subgroups, which included female students having initial and high levels of basketball technique mastery, respectively. Female basketball players with an initial level of training had an experience of training up to 3 years, while athletes with a high level of training had a playing experience of more than 10 years.

Students of the experimental group EG1 with the initial level of preparation played basketball in sectional physical

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education classes three times a week using exercise machines developed by us; students of the experimental group EG2 with a high level of preparation practiced daily (except for Sunday) within the training process of the university women's basketball team. Students of CG played basketball in sectional classes three times a week without the use of developed exercise machines and had an initial level of mastery of basketball techniques. The selection of female students in the groups of the initial level of preparation (EG1 and CG) took place at random. Athletes from the university basketball team were selected for the high-level training group (EG2). The average height of female students in all three groups did not differ significantly ($p>0.05$), and was 179.2 ± 5.6 cm.

2.2. Procedure

The research was conducted from 2016 to 2021 in four stages. The first analytical and exploratory stage (2016-2017) enabled the analysis of the state of the research problem in modern theory and practice. The second ascertaining stage of the research (2017-2018) involved pedagogical testing of female students' level of development of motor skills and comparative analysis of the obtained data of persons with different levels of basketball technique mastery in order to introduce technical equipment for the improvement of female students' motor skills and techniques. The third organizational and designing stage (2018-2019) involved the construction of "Shooting durable" and "Jump absorber" exercise machines on the basis of the obtained data and the technology involving the exercise machines' application for the development of motor skills and improvement of female students' playing techniques who are engaged in basketball. The fourth formative stage (2020-2021) involved the conduct of the pedagogical experiment, which led to the introduction of the technology of exercise machines used for motor skills' development and female students' basketball playing techniques improvement, and the conduct of the experimental test for the effectiveness of the developed technology. The pedagogical experiment lasted 10 months.

2.3. Methods

The following methods were used during the research: analysis and generalization of literature sources, testing, pedagogical experiment, and methods of mathematical statistics.

The analysis and generalization of literature sources allowed processing advanced scientific and methodical as well as practical developments concerning basketball teaching and development of female students' motor skills during basketball training sessions. The practical experience of exercise machines used in the physical education and training of athletes, in particular female basketball players, was analysed. 42 sources on the topic of the article from the scientometric databases of PubMed, Scopus, Web of Science Core Collection, and others, were analysed.

Pedagogical testing was used to assess the motor and technical training of female basketball players. The level of motor training was determined by the indicators of explosive strength of the legs: long and high jumps in cm. The level of technical training in basketball was assessed using tests: throws into the basket from the medium (4.5 m) and the long (6.25 m) distance, with 10 attempts each (the number of successful attempts was determined).

The long jump test was performed from the starting position: semi-squat with half-incline, arms back and down. The subjects took a position near the horizontal marking and performed the maximum jump forward, pushing off with both feet, and at the same time, making a forward-upward swing with their hands. The distance between the marking of the initial position and the rear extreme point of the body after landing was recorded.

The high jump test was performed from the starting position: semi-squat with half-incline standing facing the wall with vertical markings, arms back and down. The subjects occupied the starting position, touched the marking with their hand, fixed the reference point, and performed the maximum jump upwards, pushing off with both feet and, at the same time, making a forward-upward swing, again touching the marking with the hand at the highest possible height. The distance between the starting point of the marking and the upper extreme point of the body in the jump was recorded.

Determination of the accuracy of distance throws was as follows: an arc was drawn with a radius of 4.5 m with the center in the projection of the basketball hoop; the subjects performed 10 throws of the ball into the basket from any point of the arc, and recorded the number of hits. For long throws, an arc with a radius of 6.25 m was drawn with the center in the projection of the basketball hoop, the subjects performed 10 throws of the ball into the basket from any point of the arc, and the number of hits was recorded.

A pedagogical experiment was conducted to test the effectiveness of our technology involving the use of technical equipment to develop the accuracy of movement during ball throw and rebound as well as the speed and strength quality of female students with different levels of technical training in the process of basketball playing.

2.4. Statistical Methods

The digital material of the research was processed using Microsoft Excel 2013 software, as well as a modern package of statistical analysis, such as Statistica (StatSoft Inc., 2016, USA). The sampling method that determined the arithmetic mean standard deviation was used. We used the Student's t-test for unrelated samples at a significance level of $p < 0.05$ to compare the digital data of the experimental and control groups and assess the reliability of the difference between the measurement results of the control indicators in the conditions of the pedagogical experiment and the original data.

3. RESULTS

The success of learning techniques and achievements in basketball depends on various indicators of physical development and training of those involved, which necessitates the development and implementation of such technical means that stimulate high efficiency of important motor skills development, as well as the most important muscle groups for

basketball games.

When developing technical equipment, it is especially important to be able to determine the conformity of quantitative or qualitative reproduction of motor actions using exercise machines to the desired result (body position or accuracy of movements in space and time, the degree of muscular effort, etc.).

A special "Shooting durable" exercise machine was developed to improve the accuracy of basketball throws from the rim (Fig. **1**).

Fig. (1). "Shooting durable" exercise machine to develop the accuracy of ballistic movements and spatial-dynamic sensitivity during ballthrow and rebounds.

This device is designed to develop the accuracy of ballistic movements and spatial-dynamic sensitivity during ballthrow and rebounds. The exercise machine consists of a solid metal ring with a diameter of 380 mm (the basketball hoop diameter is 450-457 mm), which is fixed on top of the basketball hoop with shock-absorbing clamps. There are 4 apertures on the ring circumference at an equal distance designed to fix the metal crosspiece, which does not allow the ball to hit the basketball hoop and provides its rebound. The crosspiece is used to train the rebound of the ball; its function is to facilitate the rebound of the ball the players are fighting for. The exercise machine works to improve the accuracy of the ball throwing by removing the crosspiece due to the reduction of the basketball hoop diameter, *i.e.*, complicating the motor task.

The "Jump absorber" training system (shock absorber) for jumps was created to develop speed and strength quality to improve jumping movements, the implementation of rapid breakthroughs, and strong and long passes in basketball (Fig. **2**).

The training device for the development of speed and strength quality consists of two 350 mm long bands, which have loops with fasteners on one side, and fastened with carabiners to 800 mm long belts on the other side. The materials from which the main elements of the exercise machine are made are EVA and TPR.

Fig. (2). "Jump absorber" exercise machine to develop speed and strength quality.

The basic principle of the "Jump absorber" exercise machine operation is to develop the damping strength of the muscles of the extremities as the basis for the development of explosive strength due to the reactive ballistic type of muscle tension. The working effect is determined by the ability of muscles to quickly switch from the translational mode (reduction) to an overcoming mode (stretching) using their elastic potential, *i.e.*, the reactive ability of muscles.

The "Jump absorber" exercise machine can be used to develop explosive strength and rapid strength of arm and leg muscles by using the plyometric method of influencing the damping strength. The damping strength is the basis of many technical actions in basketball, including jumps, bursts, acceleration, fast and strong passes, and rebounds. The use of the device in the educational process increases the efficiency of the development of speed and strength quality as well as strength and endurance. However, the dosage of the load in the exercises and the conditions of their implementation in the development of rapid strength, explosive strength, and strength endurance are fundamentally different.

The loops of the exercise machine are attached to the feet of the basketball player at one end and to the waist at the other by means of the belt so that the legs in the knee joints are bent at an angle of about 90º. An effort needs to be made to overcome the resistance of the bands at the time of the leg straightening. Also, the loops can be attached to the wrists, and hand movements can be performed in different directions. Also, the exercise machine can be used to throw, pass, and catch the ball.

The action of the developed exercise machines provides the effect of combined influence, which makes it possible to simultaneously influence the development of special motor skills and learning basketball techniques.

The process of developing female students' motor skills during basketball sessions with the use of the training equipment includes the sequence and relationship of the main tasks: encouraging female students to play basketball for physical self-improvement with the help of exercise machines; formation of a system of theoretical knowledge on the use of exercise machines during basketball training sessions; direct

involvement of female students during basketball training sessions in various forms with the use of technical equipment. A characteristic feature of the process is the complex nature of the physical activity, which involves the simultaneous development of various abilities based on the implementation of the following means: conditioning, special training exercises, and techniques of the game. Exercise planning was based on taking into account the initial level of physical fitness of those involved, the direction of the impact of exercise and training devices on the body, the type of motor quality and the nature of motor tasks, and patterns of adaptation and fitness growth. The technology involving using technical equipment for the development of motor skills of female students during basketball training sessions included the use of interval exercise methods (repeated-serial method) and combined exercises (circular game and competitive methods) for the predominant influence on the development of speed, coordination and accuracy of movement, speed and strength quality, and different types of special endurance (speed, speed and strength as well as coordination ones). The volume and intensity of physical loads were found to be increased, the rest time was reduced, the nature of rest was changed from passive to active, the coordination complexity of the exercises was increased, and the conditions for performing the exercises were complicated in the process of increasing the developmental effect. Training sessions with the students were held 3 times a week to ensure the developmental effect, and independent training sessions were included according to the program. Female basketball players with a high level of training practiced every day (except for Sunday).

The use of exercise machines in groups EG1 and EG2 took place at each lesson during the general physical training aimed at developing the motor skills of basketball players. The "Jump absorber" was used during the performance of special jumping exercises by students as well as exercises to develop arm strength. The most common exercises using the Jump absorber are jumping and throwing basketball and stuffed balls, jumping from a height, squats, raising and extending the arms, *etc*.The development of rapid muscle strength of the extremities was to overcome the resistance of the "Jump absorber" with the maximum possible speed. Exercises were performed in series, and the dosage of repetitions in one series was planned taking into account the duration of continuous repetition of the exercise to reduce the frequency of movements (pace). Exercises provided a frequency of movements of 70-100% at the maximum duration of 6-8 s. The number of series was from 2-3 for entry-level students and 5-6 for high-level students. The rest interval between heart rates was 100 ± 10 beats/min or 3-5 min depending on preparedness. The development of the explosive force of the muscles of the lower and upper extremities involved the use of their own body mass with the resistance of the "Jump absorber" during the repulsive force and rapid transition from overcoming and translational muscle modes. Jumping and throwing exercises were performed continuously in 3-6 series from 5-6 (in group EG1) to 10-12 (in group EG2) continuous repetitions in a series of repetitions of the exercise after 10-30 s until there was a decrease in jumping height or throwing range. Rest between the series was planned to be active until the recovery of the pulse to the level of 90-110 beats/min (its duration being 2-3 to 6-8 minutes).

The development of speed and strength qualities of CG students in basketball classes involved the use of simple additional equipment: dumbbells, medballs, *etc*.The height of the jumps, the weight of the metal object, the number of sets and repetitions of the exercise in the series varied similarly.

To develop the spatial and dynamic accuracy of the students of groups EG1 and EG2, the ballthrows were performed from different distances into the basket with the "Shooting durable" exercise machine attached to it at each lesson. Various methods of throwing were used to master the different trajectories of the ball, which is associated with differentiation of muscular effort and adequate assessment of the spatial parameters of movement. Initially, throws were performed in different ways from constant "points", gradually increasing the distance, using alternating throws of the ball from long and short distances, from medium and long distances, under the shield, and from center, right and left flanks, *etc*.Tasks were provided in the following ways: approaches of 10 throws from each point in a stream or individual way of organizing students with a consistent change of place of the throw; 2-3 series of 2-6 approaches; 2-4 approaches from a specific or arbitrary distance up to 10 hits in a streaming or individual way of organizing students or 3-4 approaches to 10-15 hits from different points in a group way of organizing students. At the same time, active recreation with a change of activities was provided. The key feature of the Shooting durable exercise machine is a removable cross, which, when fixed, is used to teach the selection of the ball after the rebound, and its function is to facilitate the rebound of the ball for which players are fighting. Without the crossbar, the exercise machine works to improve the accuracy of the ball by reducing the diameter of the ring, *i.e*., complicating the motor task. CG students performed the same tasks without using the "Shooting durable" exercise machine.

The training equipment can be used at every stage of basketball teaching. In such a case, the greatest effect is observed at the stage of initial training, when the techniques and game actions have significant deviations from the standard. It is possible to identify errors that occur during the performance of techniques with the help of the training equipment.

When using the training equipment, it is necessary to adhere to the following organizational and pedagogical conditions of efficiency for female students' motor skills development by means of basketball, namely observance of hygienic requirements and safety of the training session places; availability of training equipment for the development of basic motor skills in the process of playing basketball; practical experience in the use of exercise machines in the process of physical education; increasing the female students' motivation toward regular motor activities during basketball training sessions; implementation of an individual approach by taking into account the level of special motor training of female students; and creating a system of objective control over the development of motor skills with the help of training equipment in the process of basketball.

The pedagogical experiment was conducted, which involved female basketball players with different levels of technical training, to experimentally study the developmental effect of basketball training sessions in the process of physical education in higher educational institutions using technical equipment, which is the direct task of the developed technology. The EG1 and EG2 experimental groups included female students with initial and high levels of basketball technique mastery, respectively. Thus, the dynamics of indicators of physical and technical training of basketball female players in the conditions of the pedagogical experiment was studied. At the same time, the assessment of motor training of female students was carried out, in particular, the development of speed and strength quality at the beginning and end of the academic year (Table **1**).

Thus, the dynamics of the level of development of the studied motor skills in the process of basketball training sessions during the academic year in all groups of female students was positive. The reliable dynamics of speed and strength quality was recorded as a result of the pedagogical testing of girls' motor training (in the EG1, EG2, and CG female students, the rate of growth of the result in long jumps was 4.3%, 3.6% and 2.3% accordingly; the rate of growth of the result in high jumps was 15.1%, 7.3% and 7.0%, respectively, at $p \leq 0.05$). It is important to note that in the long jumps in students of groups EG1 and EG2, the difference between the indicators at the beginning and end of the experiment was 9.80 cm and 8.35 cm, respectively, at $p \leq 0.05$, and in CG, the difference was 5.09 cm and it was unreliable ($p > 0.05$). A similar trend was observed in high jumps; in EG1, during the study period, the indicators increased by 7.2 cm ($p \leq 0.05$), in EG2 by 4.21 cm ($p \leq 0.05$), and in CG by 3.14 cm ($p \leq 0.05$). This indicates that the use of developed simulators more effectively affects the development of motor skills of basketball players, compared to traditional means, with the greatest effect being found in groups of basketball players with an initial level of training.

An important indicator of the effectiveness of basketball training sessions is the growth of female athletes' technical skills. For this purpose, the dynamics of the accuracy of motor actions performed by female students of the studied groups in the conditions of the pedagogical experiment was researched Table **2**. Thus, the presence of positive reliable dynamics of the level of basketball technique mastery by female students of all groups ($p \leq 0.05$) was observed based on the data comparing the results of the pedagogical testing of female students' technical training during the pedagogical experiment. However, the rate of growth of technical indicators of the EG1 female students with the initial level of playing skills was higher than that in the female students of other groups; in particular, the accuracy of throws from the medium distance increased by 29.3% and by 76.7% in the long distance, while the rate of growth in the EG2 female students in terms of their technical training in the relevant tests was 13.3% and 27.9%, respectively, and the CG female students' results in control exercises in terms of their technique increased by 11.8% and 21.3%, respectively, at $p \leq 0.05$.

This may be due to the fact that all female students of the studied groups attended basketball training sessions during the academic year, resulting in a positive increase in game performance in general and the results of individual techniques and actions in particular. However, the obtained data show that the growth rates in motor tests are higher in the experimental groups, female students are engaged in the developed technology, and the dynamics of the effectiveness of the technique in the EG2 female students with a high level of game training is lower compared to the EG1 because the initial indicators of the EG2 female students were higher.

Table 1. Dynamics of development of female students' speed and strength quality in the conditions of the pedagogical experiment (Mean ± SD).

Indicators	Groups	Before the Experiment	After the Experiment	Increase in the Indicator, %	Significance of the Difference
Long jump, cm	EG1	221.61 ± 12.51	231.41 ± 10.11	4.3	$p \leq 0.05$
	EG2	229.80 ± 13.63	238.15 ± 11.73	3.6	$p \leq 0.05$
	CG	220.12 ± 12.74	225.21 ± 8.15	2.3	$p > 0.05$
High jump, cm	EG1	44.12 ± 6.03	51.32 ± 5.89	15.1	$p \leq 0.05$
	EG2	55.52 ± 7.88	59.73 ± 4.77	7.3	$p \leq 0.05$
	CG	43.17 ± 6.84	46.31 ± 5.34	7.0	$p \leq 0.05$

Legend: Mean – arithmetical average; SD – standard deviation; p – significance of the difference between the indicators of groups before and after the experiment due to the t-test.

Table 2. Dynamics of the accuracy of motor actions of female students engaged in basketball in the conditions of the pedagogical experiment (Mean ± SD).

Indicators	Groups	Before the Experiment	After the Experiment	Increase in the Indicator, %	Significance of the Difference
Medium distance throws, number of hits from 10 attempts	EG1	3.2 ± 1.1	4.3 ± 1.2	29.3%	$p \leq 0.05$
	EG2	6.3 ± 2.2	7.2 ± 2.6	13.3%	$p \leq 0.05$
	CG	3.2 ± 1.2	3.6 ± 2.1	11.8%	$p \leq 0.05$

(Table 2) contd.....

Indicators	Groups	Before the Experiment	After the Experiment	Increase in the Indicator, %	Significance of the Difference
Long distance throws, number of hits from 10 attempts	EG1	1.2 ± 1.1	2.6 ± 1.2	76.7%	$p \leq 0.05$
	EG2	3.7 ± 1.5	4.9 ± 2.6	27.9%	$p \leq 0.05$
	CG	1.1 ± 0.9	1.6 ± 1.1	21.3%	$p \leq 0.05$

Legend: Mean – arithmetical average; SD – standard deviation; p – significance of the difference between the indicators of groups before and after the experiment due to the t-test.

Thus, the experimental testing of the technology involving technical equipment application for the development of motor skills of female students during basketball training sessions confirmed its effectiveness in terms of increasing the level of motor training and improving the technical skills of young people studying in higher educational institutions.

4. DISCUSSION

Analysis of the literature shows that recently, there has been a trend of the widespread introduction of exercise machines in the practice of physical education of students as a means of intensifying the educational process, physical development, and health improvement of students, preparing them for future professional activities [30, 31, 32]. At the same time, training devices can increase the efficiency of the educational process of physical education of students during various types of physical exercises, including sports games. The expediency of using exercise machines during sports games teaching is based on the experimentally proven possibility of purposeful control of changes in the biomechanical characteristics of movements during their reproduction in specially created artificial conditions.

Different types of exercise machines are used in the practice of teaching basketball. Thus, some scientists [24] pay considerable attention to technical and tactical exercise machines, which are divided into exercise machines of narrowly directed action (devices for the accentuated formation of a separate element of technique: effort, trajectory, execution time, etc.), intended end-use (tactical exercise machines) and multi-purpose application (devices for training techniques and tactics of attack, defense, to practice technical actions, and the development of special motor skills). At the same time, new low-cost portable types of exercise machines are gaining popularity today for training and developing the accuracy of throws, passes, agility and coordination of movement, speed, strength as well as speed and strength quality, which creates preconditions for their active use in basketball training. Thus, K. M. Charikova [33] created a training complex to develop the ability of differentiating the initial speed of the ball when performing a long pass in basketball. P. I. Donchenko [34] presented a special basketball exercise machine to teach and improve the throw of the basketball hoop. G. P. Konstantinov [30] developed and implemented a mechanical exercise machine to teach the techniques and develop the accuracy of the foul shot, which allows you to model the trajectory of the ball in the main phase of the throw using the method of one-hand from above. Other specialists developed and described an easy-to-use technical device to teach "Interdigital limiter" basketball techniques [25]. O. Tymoshenko *et al*. [17] determined the visual guidelines to develop the accuracy of basketball throws into the basketball hoop with the rebound of the ball from the shield (vertical axis of aiming, aiming and rebound lines), which are applied to the basketball shield with adhesive tape. V. N. Prytykin's and A. A. Geraskin's work [27] provides information related to other tested technical devices to teach basketball throws: "Defender's glove" aimed at complicating the conditions of throwing, "Insert-ring" was designed to bounce balls with a low trajectory, and so on. Other developers of technical means designed to teach basketball throws [26, 35], offer devices that affect the parameters of the trajectory of the ball, model points in the plane of the basket in the form of various aiming objects, and improve the accuracy (effectiveness) of basketball throws without bouncing the ball from the shield. Thus, the relevance of developing new, affordable and effective training devices to develop physical quality in the process of playing basketball in higher educational institutions is of great importance, given the high variability of motor actions in basketball and the relationship between the success of mastering the technique of the game with the development of motor skills of those involved, and despite the sufficient development of technical support for basketball teaching. Based on this, the "Shooting durable" portable exercise machine has been designed to develop the accuracy of motor actions and the "Jump absorber" exercise machine to develop speed and strength quality in female students who play basketball.

The key feature of the "Shooting durable" exercise machine is a removable cross, which, when fixed, is used to teach the selection of the ball after the rebound; its function is to facilitate the rebound of the ball for which players are fighting. Without the crossbar, it works to improve the accuracy of the ball by reducing the diameter of the ring, *i.e*., complicating the motor task. The special effect of the "Jump absorber" exercise machine is to develop the damping force of the muscles of the extremities due to the reactive-ballistic type of muscle tension. The training effect of this exercise machine is determined by the ability of muscles to quickly switch from contraction to stretching due to the use of their elastic potential, known as the reactivity of muscles.

The technical equipment application has been carried out in this study to develop motor skills of student youth in the process of basketball training sessions, taking into account the sequence and relationship of the following main tasks: the formation of motivation and the system of theoretical knowledge to use exercise machines during basketball training sessions and the direct involvement of female students in basketball training sessions with the use of technical equipment. At the same time, the complex nature of the physical activity was ensured by the simultaneous development of various motor skills on the basis of the use of the following means: conditioning, special training exercises, and techniques of the game. Exercise planning was based on the initial level of physical fitness of female students, the direction of the impact of exercise and training devices on the body, the type of motor quality and nature of motor tasks, patterns of adaptation and fitness growth. In addition, the organizational and pedagogical conditions of efficiency for female students' motor skills

development by means of basketball were taken into account, namely observance of hygienic requirements and safety of the training session places; availability of training equipment for the development of basic motor skills in the process of playing basketball; practical experience in the use of exercise machines in the process of physical education; increasing the female students' motivation toward regular motor activities during basketball training sessions; implementation of an individual approach by taking into account the level of special motor training of female students; creating a system of objective control over the development of motor skills with the help of training equipment in the process of basketball.

The introduction of the proposed exercise machines and their application in the educational and training process of female basketball players of the leading student teams of Ukraine have proved their high efficiency. The women's basketball national team of M. P. Drahomanov National Pedagogical University systematically includes the "Shooting durable" and the "Jump absorber" exercise machines in the process of their physical and technical training, thanks to which it has repeatedly won the Championship of Kyiv among female students. Thus, the women's basketball team of Dynamo-NPU won the final series of the Women's Super League of Ukraine in 2019 due to the use of the "Shooting durable" and the "Jump absorber" exercise machines during the training process, and became a bronze medallist in 2021. Andreona Keys Dynamo NPU player broke the performance record in the Women's Super League in 2020. Therefore, the basketball player scored 48 points (14/23 two-point, 1/5 three-point, and 17/18 penalties) in one of the matches of the regular championship. The women's student basketball team became a silver medallist in 2018 due to a significant increase in the level of speed and strength quality as well as the accuracy of the ball throw using our exercise machines, and it became the winner of the Kyiv Championship among female students in 2019. Moreover, 3 students of the university are part of KSLI-Dynamo-NPU team, which has repeatedly won the championship of Ukraine in basketball in the major league.

As for the students at the initial level of game readiness, who were engaged in the training involving the use of exercise machines, pedagogical observation showed that their game performance improved significantly, *i.e.*, their accuracy of throws has increased and the number of successful rebounds after unsuccessful throws in attacks has also increased, which indicates an increase in the level of accuracy and speed-power qualities of these basketball players.

The results obtained by us confirm the findings of many scientists [36 - 42], and significantly expand them.

CONCLUSION

The analysis of current trends has shown that basketball includes a wide arsenal of natural movements and actions with the ball, which allows it to be used in the motor training of female students. The use of exercise machines increases the effectiveness of physical exercise. From today's point of view, experience has been gained in creating technical devices and exercise machines for training basketball players, but the pedagogical aspect, which includes the development and use of technical means during basketball training sessions with students of different levels of game preparation, remains little studied.

Two exercise machines have been developed to increase the efficiency of motor training of young people in basketball: the "Shooting durable" to develop the accuracy of spatial-dynamic and spatial-temporal parameters of movements during ball throw and rebounds, and the "Jump absorber" to develop speed and strength quality, in particular, to improve jumping movements, to realise fast breakthroughs, as well as strong and long passes. The principle of the exercise machine operation is controlled muscular activity, which provides psychophysical readiness to effectively perform the techniques of basketball and game actions without the ball. The exercise machines have a combined effect, which allows to simultaneously influence the development of special motor skills and learning basketball techniques by improving the structure of movements and muscle sensation. The use of exercise machines for the development of motor skills of student youth in the process of basketball training has been substantiated. Therefore, the efficiency of technical equipment application to develop motor skills of female students in the basketball training sessions from the standpoint of improving the indicators of their motor training and technical skills has been proved. The improvement in the level of development of motor quality of female students of all studied groups was established in this study; however, the growth of indicators of speed and strength quality of female students of all groups turned out to be significant ($p \leq 0.05$). The presence of positive reliable dynamics of the level of basketball technique mastery by female students of all studied groups ($p \leq 0.05$) was stated. However, the growth rates of most indicators in motor tests of technical skills in the experimental group of female students were large compared to the control group of female students.

LIMITATION AND RECOMMENDATION

A major limitation of the study is the lack of control of the experimental and control group's extra-curricular physical activities during the research period.

The results of the research could be used to develop motor skills and improve the playing techniques of students of university basketball teams in the training process of basketball players at different stages of sports training, in the process of teaching basketball to schoolchildren and students, and in maintaining physical fitness of basketball players. In addition, the developed exercise machines can be adapted for the introduction of mini-basketball in the process of teaching children, as well as for physical training and technical improvement of athletes in streetball (3x3).

The prospect of further research is the design of exercise machines to develop speed, strength, and throws, and improve ball control during dribbling, *i.e.*, improving technical skills and various aspects of special motor skills of basketball players.

LIST OF ABBREVIATIONS

CG	=	Control Group
EG	=	Experimental Group

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The research was carried out according to the requirements of the Code of Ethics of National Pedagogical Dragomanov University, which was approved by the Academic Council of National Pedagogical Dragomanov University (protocol No. 1 of 02 September 2015) and implemented by order of the Rector of the University (order No. 05 of 02 September 2015). Also, this research complies with the ethical standards of the Act of Ukraine "On Higher Education" No. 1556-VII of 01 July, 2014, and the Letter from the Ministry of Education and Science of Ukraine "On the Academic Plagiarism Prevention" No. 1/11-8681 of 15 August, 2018. According to its provisions, the members of the scientific process are guided by the principles of self-sufficiency, independence in the dissemination of knowledge and information, upholding honesty, fairness, responsibility, and following ethical principles and rules of creative activity in order to establish confidence in the results of scientific achievements. The results of the research were verified and approved by the Commission on Academic Ethics and Virtue of National Pedagogical Dragomanov University (protocol No. 10 of 18 June 2021).

HUMAN AND ANIMAL RIGHTS

No animals were used for studies that are the basis of this research. The reported experiments are in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

STANDARDS OF REPORTING

STROBE guidelines were followed.

CONSENT FOR PUBLICATION

The participants of the experiment were informed about the tasks of the research and voluntarily agreed to participate in it.

AVAILABILITY OF DATA AND MATERIALS

The data supporting the findings of the manuscript «Developing Female Students' Motor Skills and Improving Basketball Playing Techniques by Means of Special Exercise Machines» is available in the Electronic National Pedagogical Dragomanov University Repository at http://enpuir.npu.edu.ua/ (http://enpuir.npu.edu.ua/handle/123456789/26738, http://enpuir.npu.edu.ua/handle/123456789/32114).

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CONFLICT OF INTEREST

The authors declare that no competing interest exists related to this research.

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