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EFFECT OF APPLYING DIFFERENT TEACHING AND LEARNING METHODS AND AIDS ON THE ACCURACY OF FREE TROWS

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CONTENTS

INTRODUCTION

Relevance of the topic. Basketball is a sports game the aim of which is to throw the ball into the opponent's basket. The improvement in basketball is directly linked to one of the most significant problems arising to basketball players, coaches and researchers: the improvement of accuracy of shooting and free throws (Nemeth, 2002; Stonkus, 2003; Emma, 2004; Sivils, 2010; Filippi, 2011). The dependence of the efficiency of shooting as the main technical action in playing basketball is manifold: the accuracy of shooting is determined by biomechanical parameters (Brancazio, 1981; Hudson, 1985; Miller, 2002; Fontanella, 2007; Bartlett, 2008), movement stability (Millslagle, 2002; Button et al., 2003; Okubo, Hubbard, 2006; Bartlett et al., 2007; Lam et al., 2009), and ability of the human body to adapt to physical loads of different intensity (McInnes et al., 1995; Ziv, Lidor, 2009; Mongomery et al., 2010) and types as well as mental abilities of players (Burke, Brown, 2002; Vealey, Greenleaf, 2006; Malinauskas, 2010).

Changes in the shooting indices during a basketball match are influenced by active actions of opponents' defence, defensive systems applied, physical and mental condition of players, the importance of the match and its result. The accuracy of free throws is specifically influenced by the result of the game and the mental condition of the players in relation to the result (Stonkus, 2003; Wissel, 2011). It has been established that free throws make 20–25 percent of all points earned per game (Kozar et al., 1994), thus the efficiency of them is of vital importance for winning (Karipidis et al., 2001; Sampaio, Janeira, 2003; Csataljay et al., 2009; Kreivytė, Čižauskas, 2010; Zuzik, 2011). High activity in the completion of attacks and stability in free throws were demonstrated by the Lithuanian Women's national Team, the champion in 1997 European Championship, having made 28 free throws per game on average, 22 of which were accurate (79 percent of accuracy), which accounted for 29 percent all merit points per game (Čižauskas, Kreivytė, 2004). It has been established that the mean accuracy of free throws of world basketball players (both men and women) per match is 76 percent. The accuracy of throws of 65 percent is considered to be poor, and the accuracy of

the best basketball players usually reaches 90 percent or more in a game (Vickers, 2007). According to the classification of motor control (McMorris, 2004; Schmidt, Wrisberg, 2007; Schmidt, Lee, 2011), free throw is a classified as a closed self-paced action because opponents do not prevent it (Singer, 2000; Lidor, 2007).

Many scientists (Lobmeyer, Wasserman, 1986; Wrisberg, Pein, 1992; Mack, 2001; Czech et al., 2004; Gooding, Gardner, 2009) claim that movement accuracy y is much determined by the preparation o perform the movement – the preparation phase. Before a free throw basketball players perform **preparatory movements and actions** which are defined as a set of motor, affective and cognitive behaviours before the performance of the main action (Kingston, Hardy, 2001; Lidor, Mayan, 2005). It has been established that preparatory actions and movements of skilled basketball players influence beginners (Singer, 2002; McMorris, 2004). According to FIBA rules, a free throw is given 5 s, thus preparatory actions for a throw are rather individual and different for each player (Boutcher, 1990; Cohn, 1990; Moran, 1996; Lidor, Singer, 2003). Research literature contains different methods of preparatory movements and actions before a free throw (Amberry, 1996; Wissel, 2005; 2011; Filippi, 2011), but Wrisberg and Pein (1992) suggest that basketball players themselves have to develop the most appropriate for them preparatory actions and movements before a free throw as well as the set of them. Our *research hypothesis (H1)* is that learning special preparatory movements and actions as well as the sets of them for a month would improve the accuracy of free throws for young and skilled basketball players.

Many researchers (Al-Abood et al., 2002; Singer, 2002; Lidor, Singer, 2003; Wulf et al., 2005; Zachry et al., 2005; Chiviacowsky, Wulf, 2007; Wulf, 2007 a, b) emphasize **attention concentration** before an independent action. In the context of a competition the attention must be concentrated to the performance of the specific action; otherwise it can be distracted by the noise of the crowd, movements near the court or other similar irritants (Martens, 1999, 2004; Malinauskas, 2010; Weinberg, Gould, 2010). Attention can be concentrated **inwards and outwards.** Attention focused inwards is attention to the details of the performed movement, e.g. arms, range of motion, speed; attention focused outwards is attention to the final target of movement and/or

the environment (Skurvydas, 2008). At present researchers recommend to focus attention outside the movement. Another *hypothesis (H2)* is that after one month of teaching attention concentration for young and skilled basketball players, their focus of attention to the external factor (the front part of basketball hoop) will have more positive effect on the accuracy of free throws compared to their focus of attention to the internal factor (watching the final movements of their arm).

Preparatory movements and actions as well as attention concentration to external factor during a free throw do not guarantee movement stability and accuracy if an incorrect skill in technical action performance is developed (Sowders, 2006; Vann, 2010). It is well known that if we want to change a skill, we need to stop the processes of an old activity and develop a new skill (Vilkas, 2006). Aiming at consolidating correct shooting skills and seeking for high sports results it is recommended to use various **non-traditional technical aids** (special splints, training balls), facilities (reduced hoops, stands for the improvement of shooting trajectory) which affect the accuracy of the shooting process and the stability of its separate parts (movements) (Foley, 2005; Coryatt, 2007; Heystek, Atwood, 2010; Moye, 2011). Wolf (2006) suggests that learning and improving the technique of shooting with one hand from the shoulder with the help of a **special shooting strap** for the non-shooting hand, the correct hand position will be formed holding the ball and shooting with the main focus on the non-shooting hand. *The hypothesis (H3)* is that after a month of teaching with a special shooting strap and using special methods, the technique, accuracy and the application of skills in free throws for skilled basketball players will improve in contest activities. Palubinskas (2004) established that shooting accuracy was affected by the hand position on the ball, and a **special training ball** was developed on the basis of his recommendations. This ball helps to capture the exact position of the shooting hand and fingers during shooting, i.e. efficiently form and consolidate the steady movements of hand and fingers releasing the ball (detaching the ball from hand). Though the special aids (shooting strap, training ball) have been developed to improve the efficiency of shooting, there is still nor research or publication of the world of sports science on this topic, so the findings of this research will be new information both for sports specialists and for coaches-

practitioners. *The hypothesis (H4)* is that after a after a month of teaching shooting with the help of supportive aids (shooting strap, training ball) and methods, the shooting technique and accuracy of young basketball players will improve and the new correct shooting skills will be retained for a long time.

The accuracy of free throws during the practice session and the match is different: the basketball players are more accurate during the practice sessions. The difference can be explained by different shooting conditions: during the practise sessions the free throws are made in sets (e.g. 10 throws), during a match – two and sometimes three free throws. **Constant conditions for practice** help to master the movement which will be performed automatically later (Adams, 1987; Ackerman, 1988) and **variable conditions for practice** allow the player to remember the skills better, especially when it is necessary to use it in dynamic conditions of application (Schmidt, 1975; Schmidt, Wrisberg, 2007; Skurvydas, 2008). For this reason the skills the application situation of which do not change are trained under constant practice conditions, and skill which conditions of application vary are trained under variable practice conditions. Some research findings suggest that variable practice conditions can be even more useful for skills the application conditions of which do not change (Ghodsian et al., 1997). *The hypothesis (H5)* is that the subjects who were learning under constant (standard) conditions will demonstrate better results during practice sessions and testing compared to those subjects who were learning under variable conditions, but it is likely that this level of improvement will remain shorter than the results obtained while training under variable conditions of practise.

Establishing and assessing the stability of accuracy of the **main basketball technical action – shooting –** you cannot rely only on the results of a match. Specific requirements for shooting accuracy can be established only on the basis of direct research and measurements of indices obtained in objective situations of the game or close to the game (Miller, Bartlett, 1996; Stonkus, 2003; Balčiūnas, 2005).

The accuracy of free throws of Lithuanian national team basketball players and teams (in different age groups) markedly lags behind the one of other teams winning prizes at European and world championships (Kreivytė, Čižauskas, 2007). Comparatively low accuracy of free throws during the

matches compared to the accuracy of free throws during the practice sessions encourage looking for effective methods and means to improve the efficiency of free throws. It has been established that in adolescence (12–15 years of age), complex coordination motor skills improve (Prudden, 2006; Skurvydas, 2008) together with the main characteristics of technical fitness of a player – stability and accuracy of action (Balčiūnas ir kt., 2009; Sivils, 2010; Filippi, 2011). After the study of research on shooting technique, the dependence of its stability and accuracy, being aware of the theoretical and practical importance of such research, we raise the following **research problem: what effect do preparatory movements, attention concentration, technical aids, stable and changing learning conditions have on the accuracy of free throws for young and skilled female basketball players?**

Research aim: to investigate the effect of the application of teaching and learning methods and aids on the accuracy of free throws.

Research objectives:

1. To investigate the effect of movement and action methods on the accuracy of free throws.
2. To investigate the effect of attention concentration methods on the accuracy of free throws.
3. To investigate the effect of a special shooting aid – shooting strap – on the accuracy of free throws for skilled female basketball players.
4. To investigate the effect of application of special shooting aids (special training balls, shooting strap) on the accuracy of free throws for young female basketball players.
5. To investigate the effect of different learning conditions (constant and variable) on the accuracy of free throws.

Research object: effect of accuracy improvement methods for free throws.

Conceptual research ideas are grounded on the following theoretical provisions:

1. Meta-cognitive abilities (Flavell, 1979). These abilities allow following one's own thinking processes (recognition of thinking strategies and their application), selecting effective strategies and applying them with the aim to perform certain tasks (setting goals, planning), using self-regulation

mechanisms (observations or control (evaluation of the efficiency of activities), regulation, questioning, reflection (analysis, synthesis, generalization), critical evaluation of the achieved result (reflection)) (Suchanova, 2008).

2. Singer's Five-Step Approach (Singer, 1988). The learning course consists of: **1) preparation** (the preparation for the task is meant to be stable), **2) imagining** (viewing oneself in imagination as performing an action), **3) attention concentration** (concentrating at one factor linked to the task), **4) performance** (performing the task without thinking about the performance and its outcomes) and **5) evaluation** (using the available information for further learning) before, during and after the performance of a learnt task (Lidor, 2007).

3. Psychological movement learning theory (Schmidt, Lee, 1999). This theory emphasizes the importance of developing a clean motor programme for the performance of movements. It depends on the motive, aim and attention concentration (ability to concentrate) (Skurvydas, 2008).

4. Scheme theory of motor learning (Schmidt, 1975). The pace of motor learning is determined by the solidity of motor performance scheme in the brain and the ability to use it fast and to modify it fast in an urgent situation. The more flexible the scheme, the easier the movements learnt under certain conditions can be transferred to different conditions (Skurvydas, 2008).

5. Variety of motor learning conditions (Neumann, Ammons, 1957). The more variable the tasks, the better the movement is retained in memory (motor scheme), the more complex movements and actions are taught, the lower conditional interference will occur (the less interference of learnt movements for learning new movements) (Shea, 1980; Shea et al., 2000).

Originality of the dissertation

Research results have shown that application of preparatory movements and actions before carrying out an independent action – a free throw – is effective for young female basketball players, the changing the sequence of those actions is not effective for skilled female basketball players. We have established that during an independent action, attention concentration to an external factor (the front part of the basketball hoop) is not so important for young female basketball players compared to skilled basketball players. Before an independent action unskilled athletes have to feel and to understand the

integrity of the whole movement and focus their attention to the accuracy of movement. Aiming at modifying the skill of a free throw and creating a new correct skill and consolidating it, it is efficient to use special aids. We have established that the most effective aid to improve shooting technique is a special shooting strap. Application of it has markedly improved the shooting accuracy of both skilled and young female basketball players. The significant fact is that this aid is effective for retaining the skill in memory for a long time and transferring it to contest situations. Application of special aids helped to form a correct pattern of holding the ball before a shot and decreasing the situational indices of the ball's movements to the sides in regard to the basketball hoop. It has been established that during the stable tasks, the application conditions of which do not change much, their accuracy improved only when training both under constant and variable practice conditions; however, the variable conditions of practice are advantageous for the retention of the skill. We believe that all those findings undoubtedly expand the theory and methods of training basketball players, especially those parts which are linked to motor learning.

Theoretical and practical significance of the dissertation

The research findings are linked to theoretical teaching and their application in practice, they can provide useful information necessary for modelling the strategy of training basketball players with the aim to improve the quality of practice sessions and thus to perfect the game activities during the match. This information can also be useful teaching children new shooting skills and improving the shooting technique of elite basketball players. We suppose that using non-traditional teaching aids, those findings and conclusions will have not only theoretical, but also practical significance improving the accuracy of shooting skills and free throws of players with different athletic experience.

Statements to be defended:

1. The effectiveness of application of methodology of preparatory movements, actions and their sequence performing the main action – a free throw.

2. The effectiveness of attention concentration to the external factor on the accuracy of a free throw.

3. The effectiveness of application of a shooting strap on the accuracy of free throws for skilled female basketball players.

4. The effectiveness of application of special aids teaching and practising correct technical action of shooting for young and skilled female basketball players.

5. The effectiveness of application of variable learning conditions performing a constant non-changing action – a free shot.

1. MATERIALS AND METHODS OF THE STUDY

1.1. The subjects

The indices of the sample, age, body mass and height for subjects who voluntarily agreed to participate in the research are given in Table 1.

Table 1. **The number of subjects, their age, body mass and height** (mean ± SD)

Studies	Group	Sample (n)	Age (years)	Body mass (kg)	Height (cm)
Study I Effect of application of preparatory movements and actions before shooting on the accuracy of free throws	EG	14	14.3 ± 0.3	61.8 ± 5.3	174.6 ± 8.8
	CG	14	14.4 ± 0.5	62.4 ± 4.8	173.8 ± 7.6
	EG	8	21.3 ± 1.4	66.8 ± 7.9	173.0 ± 7.1
	CG	8	21.0 ± 1.7	65.8 ± 7.8	173.9 ± 6.5
Study II Effect of attention concentration on the accuracy of free throws	EG	18	14.7 ± 0.5	60.8 ± 6.1	175.8 ± 7.8
	EG	16	22.3 ± 1.7	64.0 ± 8.7	173.4 ± 6.6
Study III Effect of special aid – shooting strap – on the accuracy of free throws for skilled female basketball players	EG	7	20.2 ± 1.2	66.5 ± 7.2	178.5 ± 3.6
	CG	7	21.8 ± 2.0	66.3 ± 3.7	176.2 ± 3.8
	EG	14	19.0 ± 0.9	67.8 ± 8.1	179.4 ± 9.4
Study IV Effect of the application of special aids (shooting strap and ball) on the accuracy of free throws for young female basketball players	EG	12	14.3 ± 0.7	63.5 ± 6.1	172.3 ± 6.1
	EG	12	14.2 ± 0.5	63.8 ± 4.6	173.4 ± 5.9
	EG	12	14.3 ± 0.6	62.4 ± 6.8	173.5 ± 5.6
	CG	18	14.3 ± 0.5	61.9 ± 6.7	170.9 ± 5.0
Study V Effect of the application of variable learning conditions on the accuracy of free throws	EG	34	20.2 ± 0.7	–	–
	EG	33	20.3 ± 0.6	–	–
	EG	32	20.7 ± 1.1	–	–

Note: EG – experimental group; CG – control group.

Study I included female basketball players from the Lithuanian Academy of Physical Education, members of the Lithuanian national youth team (U20) participating in Lithuanian students basketball championship and preparing for the European championship. Study II involved 14–15-year-old female basketball players from Kaunas basketball school "AISČIAI". Studies III and IV included both female basketball players from the Lithuanian Academy of Physical Education and young female basketball players from Kaunas basketball school "AISČIAI". Study V involved second year students from the Lithuanian Academy of Physical Education, Sports Coaching study programme (64 men and 35 women).

1.2. Methods of research

1. *Method of systemic research literature review.* This method allowed selecting and revealing dominating theories of application of complex movements for basketball players – shooting technologies and athletic fitness as well as problem questions; substantiating theoretical and methodological provisions of the pedagogical experiment; finding and substantiating unrealized possibilities in education; analyzing, comparing and interpreting research results.

2. *Pedagogical experiment:* The aim of the experiment in Study I *"Effect of application of preparatory movements and actions before shooting on the accuracy of free throws"* is to investigate the effect of application of preparatory movements and actions before shooting on the accuracy of free throws. Female basketball players in two experimental groups learnt free throws using preparatory movements and actions and their sequence according to the methodology of American scientist Amberry (1996) – a seven-step-action model:

Action 1: Enter the free throw line, feet pointing perpendicularly to it.

Action 2: Dribble the ball three times with the ball's inflation hole up.

Action 3: Place the thumb into the ball groove the middle finger pointing to the inflation hole.

Action 4: Pull the elbow to the body.

Action 5: Bend the knees.

Action 6: Focus the eyes at the target (the front part of the basketball hoop).

Action 7: Throw the ball and complete the shooting action.

Before learning the basketball players in the experimental group were explained how to perform preparatory movements and their sequence. While the basketball players performed free throws, they were observed if they performed the preparatory movements correctly and if they followed the indicated sequence of actions. The subjects on two control groups performed free throws as usual, as they had learnt earlier without any extra information. Three times a week the subjects performed 30 free throws in sets of three free throws: after two first free throws the partner gave the ball straight into the hands, but after the third throw the subject ran for the ball herself and then stood for a new set of throws. We registered the number of accurate shots and evaluated their accuracy.

The aim of the experiment in Study II *"Effect of attention concentration on the accuracy of free throws"* was to investigate the application of attention concentration in sports skills at different ages. Performing a free throw, attention was focused on the internal factor – closing movement of the wrist of the shooting hand, or the external factor – the front part of the basketball hoop. Attention concentration tasks were equally distributed among the subjects, i.e. the same number of subjects started learning to focus attention to the internal factor, and then to the external factor, and vice versa. The group, who had to concentrate attention to the external factor, i.e. the front part of the basketball hoop, had their target market with a bright tape. The group, who had to focus attention to the internal factor, i.e. closing movement of the wrist of the shooting hand, were instructed to pay attention to the correct hand and finger closure. While performing free throws, the basketball players were observed if they performed movements correctly and if they followed the given requirements. Three times a week the subjects performed 30 free throws. We registered the number of accurate shots and evaluated their accuracy.

The aim of the experiment in Study III *"Effect of special aid – shooting strap – on the accuracy of free throws for skilled female basketball players"* was to investigate the effect of the methodology of using a special shooting

strap, developed by American specialist Wolf (2006), on the accuracy of free throws. Two experimental groups received special shooting strap (if the player was right-handed, the left hand was run into the strap, and if she was left – handed, the same was done with the right hand). The players in the control group performed free throws as usual, without special shooting straps. The free throws were made four times a week during the practice sessions after a standard warm up. Each player performed 100 free throws. After each throw she had to run for the ball and then again stood at the free throw line. We registered the number of accurate shots and evaluated their accuracy. Aiming at evaluating the formation of a new skill, its efficiency and durability after learning, we registered the indices of free throws during the match.

The aim of the experiment in Study IV *"Effect of the application of special aids (shooting strap and ball) on the accuracy of free throws for young female basketball players"* was to establish the effect of the application of special aids (shooting strap and ball), meant to improve the shooting technique, on the accuracy of free throws for young (14–15 year-old) female basketball players. The study involved four groups of basketball players: three experimental and one control. The players in the first experimental group received special shooting strap which immobilized the movement of the supporting hand while shooting. The players in the second experimental group performed free throws with special training balls. The players in the third experimental group performed free throws with a shooting strap and a special training ball at the same time. The players in the control group performed free throws as usual, without any special aids. Each player performed shots four times a week (n = 100), and she had to take the ball herself after each free throw.

The aim of the experiment in Study V *"Effect of the application of variable learning conditions on the accuracy of free throws"* was to evaluate the effect of the application of variable and cosntant learning conditions on the accuracy of free throws performing a constant task the applicability of which does not change under variable conditions. Three experimental groups (LAPE students in the programme of Sports Coaching) practised shooting under different (constant and variable) conditions.

3. *Pedagogical observation.* Successful shots were registered using conventional signs in the research protocol: the shots rebound from the panel,

touching the hoop (the front part, the right side, the left side), without touching the hoop; inaccurate shots: rebound from the panel, from the hoop (the front part, the right side, the left side), without touching the hoop. The evaluation scale of shot according to the target was constructed according to the methodology of Zachry (2005) – 5-point scale:

5 points – when the ball is shot accurately without touching the hoop or the panel;

4 points – when the basket is made with the ball hitting the front part of the hoop;

3 points – when the basket is made with the ball hitting the right or the left side of the hoop;

2 points – inaccurate shot when the ball rebounds from the front part of the hop or panel;

1 point – inaccurate shot when the ball rebounds from the right or the left side of the hoop;

0 points – inaccurate shot when the ball does not touch the hoop or the panel.

4. *Testing.* In all the phases of the experiment, as well as before teaching new movements, the initial testing was carried out where the level of all subjects was evaluated before the experiment.

Test of movement stability and accuracy – **free throws:**

Test I – *30 free throws* (used in study I, II and V). The subjects performed 30 free throws each in sets of three shots. After the first free throw the partner accurately hands in the ball to the subject. After the second free throw the partner again hands in the ball. After the third free throw the subject herself runs for the ball and then stands at the line of free throws to perform another set of free throws. All in all ten sets of three throws are performed. The test result is as follows: the successful shots are calculates in percent from all the shots made.

Different variants of free throw test have been applied by many researchers (Butautas, 2002; Stonkus, 2002, Balčiūnas, 2005; Balčiūnas, Garastas, Stonkus, 2009; Железняк, 1984). This test complies with the nature of free shots performed at the competition (mostly one player can make three free throws at a time).

Test II – *100 free throws* (used in study III and IV). The subjects performed 100 free throws: after each shot the player ran for the ball herself and then stood at the free throw line. The result of the test was as follows: the number of successful shots is converted in percent form all the shots made. If we want to change the incorrect pattern of shooting we need to perform quite many free throws. Different variants of 100 free throw test (according to the subjects' age it is possible to perform sets of 10, 20 or 25 throws) have been applied by many authors (Amberry, 1996; Wolf, 2006; Filippi, 2011).

5. *Analysis of official documents.* Aiming at verifying the effect of special aids on the accuracy of free throws (study III), the development of a new shooting skill, its retention and transfer to contest situations, we performed the analysis of free throw indices of LAPE female basketball players (number and accuracy) in the matches of championships in the Lithuanian Students Basketball League (LSBL) in the season of 2007–2008 before the experiment (matches in the first stage, n=7) and after the experiment (matches in the second stage, n=13). We also analyzed the statistical protocols of the games for the Lithuanian Women's Basketball National Team in the European basketball Championship 2008 (n = 9). For the comparison of indices we studies the statistical protocols of the games of the European basketball Championships of 2007 and 2009 (n = 16). The accuracy of shots (%) was chosen for analysis.

6. *Statistical analysis.* We calculated arithmetic means of indices ($\bar{x}$) and mean standard deviations (S). Size effect between groups and different testing was calculated using two-factor analysis of variance. The significance was set at $p < 0.05$. The calculations were performed using Office Excel 2003 and IBM SPSS Statistics 19 program package.

2. RESEARCH ORGANIZATION

2.1. Study I. *Effect of application of preparatory movements and actions before shooting on the accuracy of free throws*

The research methods applied:

- experiment;
- testing free throws.

The subjects were 14–15-year-old young basketball players and Lithuanian Academy of Physical Education basketball players. The course of the study is given in Figure 2.1.

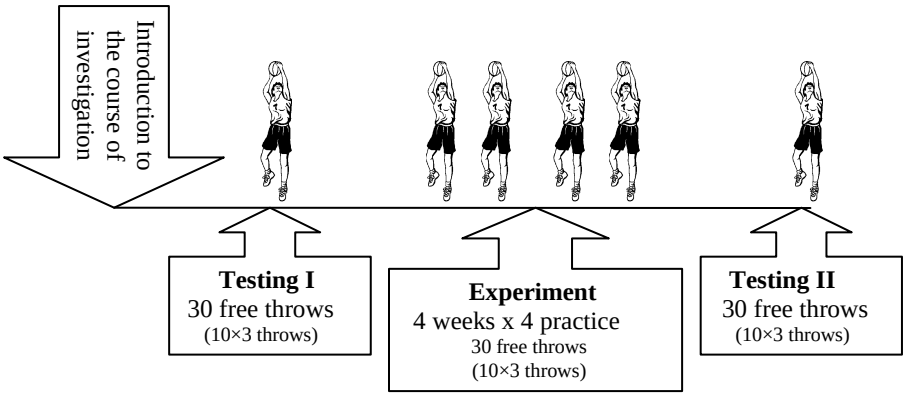


Figure 2.1. **The course of the study of the application of preparatory movements and actions before shooting**

Warm-up. At the beginning of testing the subjects performed special running exercises with a ball at low intensity (pulse rate did not exceed 130 beats/min^{-1}) for 10minutes.

Testing before the experiment. Before teaching the first testing was carried out (Test I – 30 free throws) and the subjects were divided into experimental and control groups according to the accuracy indices of free throws.

Experiment. Before the experiment the experimental group was provided with all information and preparatory movements were demonstrated as well as their sequence according to the methodology of Amberry (1996). After warm up during all practice sessions the subjects performed 30 free throws (10 sets of three free throws) according to new methods. The control group performed free throws (10 sets of three free throws) under usual conditions, as they had learnt before. The teaching lasted for one month, and practice sessions took place four times a week, 16 practice sessions all in all.

Testing after the experiment. After teaching another testing of free throws was carried out aiming at establishing the effect of application of preparatory movements and actions before shooting on the accuracy of free throws.

2.2. Study II. *Effect of attention concentration on the accuracy of free throws*

The research methods applied:

- experiment;
- testing free throws.

The subjects were 14–15-year-old young basketball players and Lithuanian Academy of Physical Education basketball players. The course of the study is given in Figure 2.2.

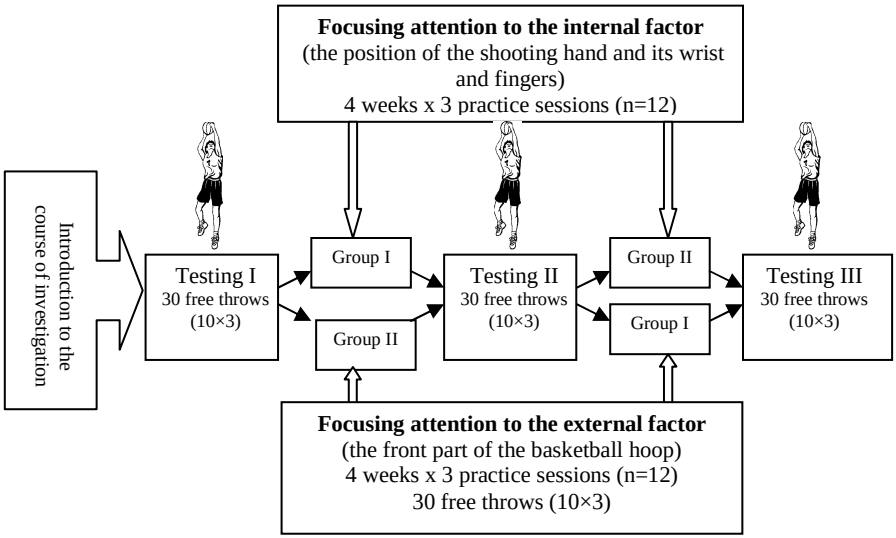


Figure 2.2. **The course of the study of attention concentration to the external and the internal factor before performing a free throw**

Warm-up. At the beginning of practice and testing the subjects performed special running exercises with a ball at low intensity for 10minutes.

Testing before the experiment. Before the experiment the first testing was carried out and the subjects were divided into one of two experimental groups according to the accuracy indices of free throws: group I learnt to perform free throws focusing their attention to the external factor (the front part of the basketball hoop), and group II learnt to perform free throws focusing their attention to the internal factor (the position of the shooting hand and its wrist and fingers).

Registering free throws. Successful and missed free throws of each subject were registered in a special protocol. We also registered if the basket was made or not according to the scale of targeting.

Stage I of the experiment. After the first testing of free throws the subjects learnt shooting for four weeks, three times a week. During each practice session the subjects performed 30 free throws.

Testing after the first stage of the experiment. At the end of teaching the second testing was carried out aiming at evaluating the effect of learning conditions on the accuracy of free throws.

Stage II of the experiment. In the second stage of learning the conditions were changed: the group who had focused their attention on the external factor now concentrated on the internal factor, and vice versa. The numbers of training sessions and free throws were the same as in the first stage.

Testing after the second stage of the experiment. At the end of teaching the second testing was carried out aiming at evaluating the effect of different learning conditions on the accuracy of free throws.

2.3. Study III. *Effect of special aid – shooting strap – on the accuracy of free throws for skilled female basketball players*

Research methods applied:

- experiment;
- testing free throws;
- analysis of official documents (official protocols of matches).

The study involved female basketball players of the Lithuanian Academy of Physical Education (n = 14) and of the Lithuanian Youth Women's Basketball National Team (n = 14). The course of the study is given in Figure 2.3.

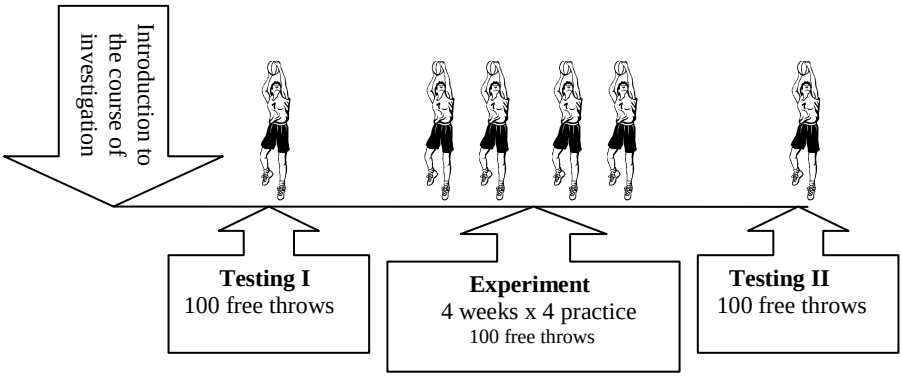


Figure 2.3. **The course of the study applying a special shooting strap**

Warm-up. At the beginning of testing the subjects performed special running exercises with a ball at low intensity for 10minutes.

Testing before the experiment. Before the experiment the first testing of free throws was carried out, and according to the accuracy indices of free throws the LAPE basketball players were divided into the experimental and control groups. The basketball players of the Lithuanian Youth Women's Basketball National Team were included into one experimental group.

Experiment. One day after testing the subjects performed free throws. The teaching lasted for four weeks, four times a week. During each practice session they performed 100 shots. The subjects were informed about the aims of the special aid, but they were explained that the aid did not necessarily have to influence the accuracy of shots.

Testing after the experiment. After the experiment, another testing (100 free throws) was performed aiming at evaluating the effect of a shooting strap on the accuracy of free throws.

Registering free throws during a match. We registered accuracy indices of free throws for 12 basketball players during a match. All in all, we analyzed the indices of 14 matches (7 matches before the experiment and 7 matches after the experiment). We also

analysed the accuracy indices of the basketball players of the Lithuanian Youth Women's Basketball National Team. We used the statistical protocols of European basketball championships: of 2007 (n=9) before teaching and of 2008 (n=9) after teaching.

2.4. Study IV. *Effect of the application of special aids on the accuracy of free throws for young female basketball players*

Research methods applied:

- experiment;
- testing free throws;
- pedagogical observation;

The subjects were 14–15-year-old young basketball players. The course of the study is given in Figure 2.4.

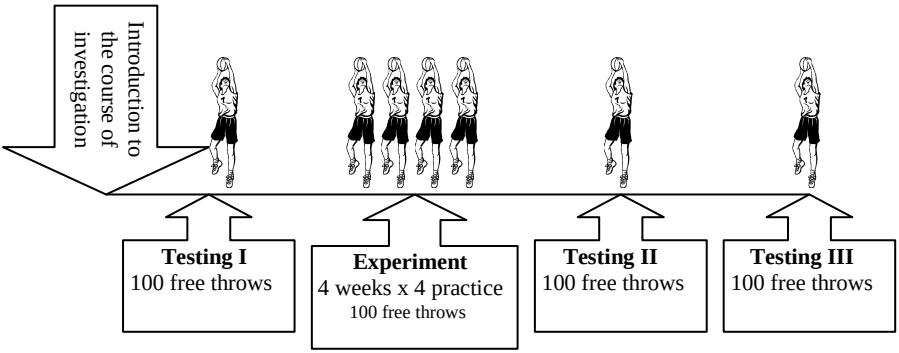


Figure 2.4. **The course of the study of using special shooting aids**

Warm-up. At the beginning of testing the subjects performed special running exercises with a ball at low intensity for 10minutes.

Testing before the experiment. Before the learning the first testing was carried out, and according the accuracy indices of it the players were divided into three experimental groups: group I learnt to

perform free throws using a special shooting strap, group II – using a special training ball, and group III – using both a shooting strap and a training ball. Control group performed the same test of free throws.

Registering free throws. The shots both made and missed were registered in a special protocol. We also evaluated the shots according to a special accuracy to the target scale.

Experiment. After the first testing of free throws, the subjects practised performing free throws using different special aids for four weeks, four practise sessions a week, 16 practice sessions all in all. During each practice session they performed 100 free throws.

Testing after the experiment. After the experiment another testing (of 100 free throws) was performed aiming at evaluating the effect of different learning conditions on the accuracy of free throws.

Testing after a break. Aiming at establishing the retention of the skill, the third testing was carried out after 7-month break.

2.5. Study V. *Effect t of variable learning conditions of the accuracy of free throws*

Research methods applied:

- experiment;
- testing free throws.

The subjects were second-year LAPE students of the Sports Coaching programme (64 men and 35 women). The course of the study is given in Figure 2.5.

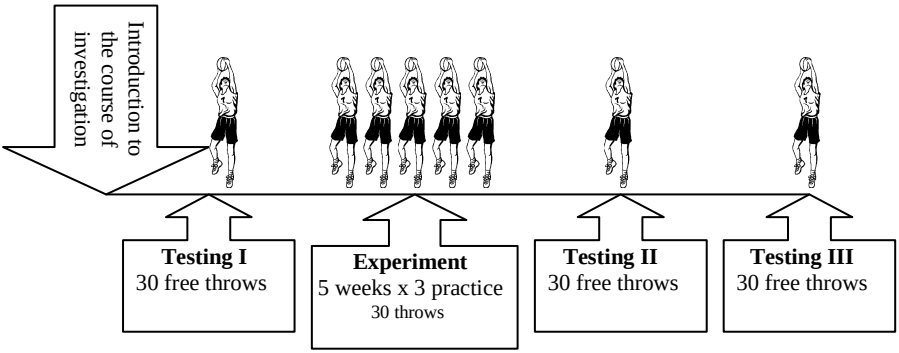


Figure 2.5. **The course of the study applying variable learning conditions**

Warm-up. At the beginning of testing the subjects performed special running exercises with a ball at low intensity for 10minutes.

Testing before the experiment. After the trial of free throws, the first testing was performed, and according to the accuracy indices of it the subjects were divided into one of three learning groups (one group who learnt under constant learning conditions, and group I and group II – variable learning conditions).

Experiment. After the first testing, when the subjects were introduced to correct technique of shooting, they learnt for five weeks, three times a week. During each practice session all subjects performed 30 free throws. All successful shots of each players were registered in a special protocol indicating the learning conditions.

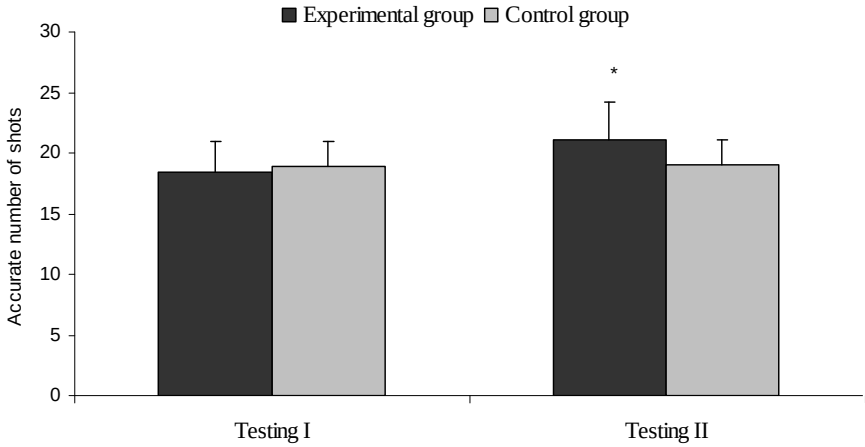
Testing after the experiment. After the experiment the second testing of free throws was carried out aiming at evaluating the effect of different learning conditions on the accuracy of free throws.

Testing after a break. After the second testing a three-week break was made, and then the third testing of free throws was carried out aiming at evaluating the retention of the skill learnt.

3. RESEARCH RESULTS

3.1. Study I. *Effect of application of preparatory movements and actions before shooting on the accuracy of free throws*

Studying the accuracy of free throws for young basketball players. After performing the analysis of the effect of preparatory movements and actions on the accuracy of free throws we established that the accuracy indices of young (aged 14–15) female basketball players during the first testing were as follows: 61.3% (18.4 ± 2.6 accurate free throws) for experimental group basketball players, and 63.0% (18.9 ± 2.1 accurate free throws) for control group players (Figure 3.1.1.). In the first testing there were no statistically significant differences between the accuracy indices of free throws of both groups ($p > 0.05$).

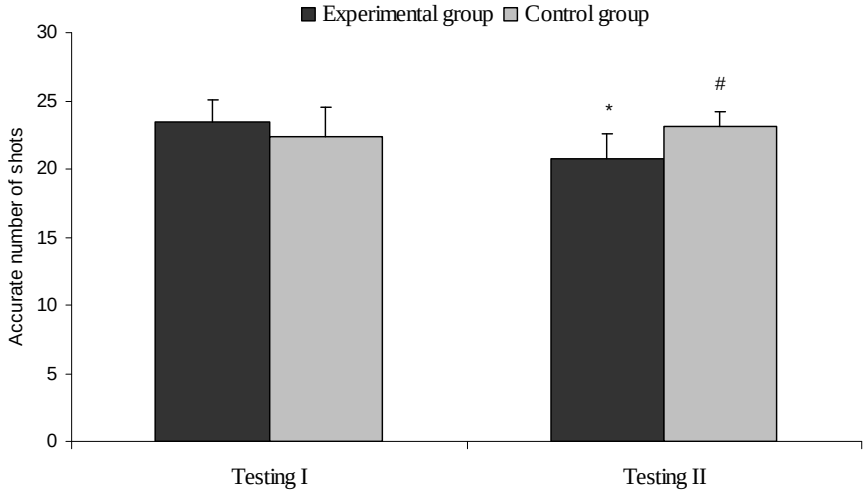


Note. * – $p<0.05$, compared to the mean value of the first testing in experimental group

Figure 3.1.1. **Free throw indices of young female basketball players before the experiment and after it performing a test of 30 free throws**

After a month of learning, when the experimental group learnt free shots applying a sequence of preparatory movements and actions before them, the second testing was carried out, and the results of it were as follows: for players in the experimental group 70.3% (21.1 ± 3.1 accurate free throws), for players in the control group 63.3% (19.0 ± 2.1). The indices of the second testing showed that the average number of successful free throws in the experimental group statistically significantly increased ($p < 0.05$) compared to the results of the first testing. The same index in the control group changed as well, but we did not establish statistically significant difference ($p > 0.05$). When those indices were compared between the groups, we found that the indices of the experimental groups were statistically significantly higher ($p < 0.05$) compared to those of the control group.

Studying the accuracy of free throws for LAPE female basketball players. The indices of accurate free throws of LAPE basketball players during the first testing were as follows: in the experimental group 78.0% (23.4 ± 1.7 accurate free throws), in the control group 74.7% (22.4 ± 2.1 accurate free throws). Comparing the indices of accurate free throws in the first testing, we did not establish any significant difference between the average indices in both groups ($p > 0.05$). After a month of teaching, when the experimental group learnt to perform free throws using the programme of the sequence of preparatory movements and actions, and the control group practised free throws as usual, the accuracy indices in the second testing were as follows: in the experimental group 69.3% (20.8 ± 1.8 accurate free throws) and in the control group – 77.0% (23.1 ± 1.1) (Figure 3.1.2).



Note. * – $p < 0.05$, compared to the mean value of the first testing in experimental group; # – $p < 0.05$, comparing the mean values of the second testing in both groups

Figure 3.1.2. **The number of accurate free throws of LAPE female basketball players performing a test of 30 free throws before the experiment and after it**

The indices of the second testing showed that in the experimental group the average number of successful free throws significantly decreased ($p < 0.05$) compared to the first testing. In the control group, this index did not change statistically significantly ($p > 0.05$). Comparing the average indices of accurate free throws between the groups we found a statistically significant difference ($p < 0.05$).

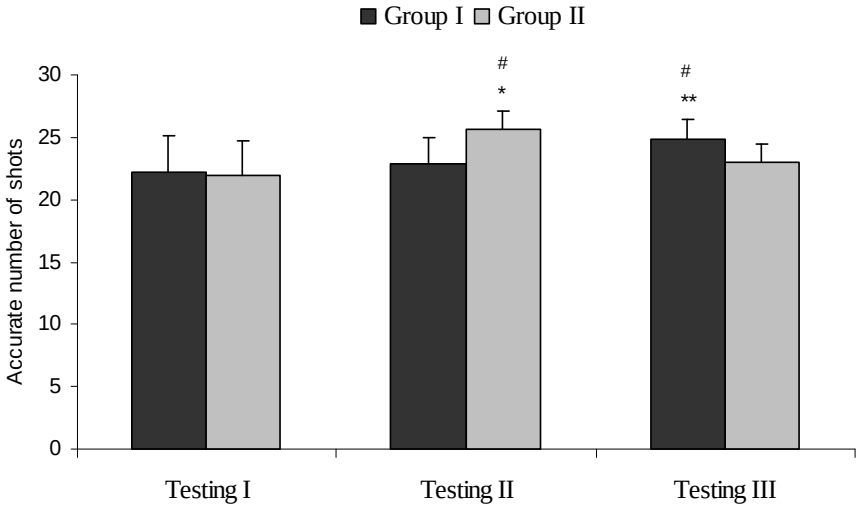
3.2. Study II. *Effect of attention concentration on the accuracy of free throws*

Studying the attention concentration of young female basketball players. The first testing (30 free throws) before teaching showed that the accuracy of both groups of young (aged 14–15) female basketball players was: 62.3% (18.7 ± 3.1 accurate free throws) in the first group and 64.7% (19.4 ± 3.4 accurate free throws) in the second group. Comparing the indices of accurate free throws in the first testing, we did not establish any significant difference between the average indices in both groups ($p > 0.05$). After a month of learning, when the experimental groups learnt to perform free throws concentrating attention to specific factors (external and internal), the accuracy indices in the second testing were as follows: 59.7% (17.9 ± 3.5 accurate free throws) in the first group of basketball players who concentrated on the internal factor (the final movement of the wrist), and 56.7% (17.0 ± 3.0 accurate free throws) in the second groups of players who concentrated on the external factor (the front part of the basketball hoop). The indices of free throws in the second testing showed than they did not significantly change compared to the indices in the first testing ($p > 0.05$). We also did not find significant differences between the groups of subjects ($p > 0.05$).

After the second testing both groups changed learning conditions: those basketball players who had concentrated their attention on the internal factor (the wrist) now concentrated on the external factor (the front part of the basketball hoop), and vice versa. After one month of learning, the results of the third testing showed that the indices of the first group who now concentrated on the external factor were 60.7% (18.2 ± 2.5 accurate free throws), and those in the second group concentrating on the internal factor were 63.7% (19.1 ± 2.6). The indices of free throws in the third testing showed than they did not significantly change compared to the indices in the first and the second testing ($p > 0.05$). We also did not find significant differences between the groups of subjects ($p > 0.05$).

Studying attention concentration of LAPE female basketball players. Before learning, the indices of accurate free throws in the first testing showed

that in the first experimental group they were 74.3% (22.3 ± 2.9 accurate free throws) and in the second experimental group they were 73.3% (22.0 ± 2.7 accurate free throws) (Figure 3.2.1.). Comparing the indices of accurate free throws in the first testing, we did not establish any significant difference between the average indices in both groups ($p > 0.05$).



Note. * – $p < 0.05$, compared to the mean value of the first testing;
– $p < 0.05$, compared to the indices in the first group;
** – compared to the indices in the same group.

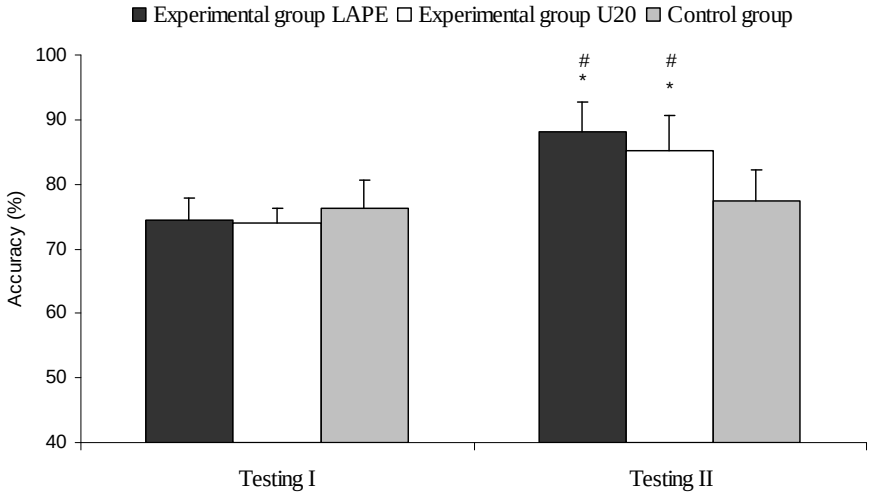
Figure 3.2.1. **The indices of free throws of LAPE female basketball players before learning (testing I), after the first stage of learning (testing II) and after the second stage of learning (testing III) performing a test of 30 free throws**

After a month of learning, when the experimental groups learnt to perform free throws concentrating attention to specific factors (external and internal), the accuracy indices in the second testing were as follows: 76.3% (22.9 ± 2.1 accurate free throws) in the first group of basketball players who concentrated on the internal factor (the final movement of the wrist), and 85.3% (25.6 ± 1.5 accurate free throws) in the second groups of players who concentrated on the external factor (the front part of the basketball hoop).

After the first phase of learning, the indices of the second testing showed that in the first group of subjects who concentrated on the internal factor (the final movement of the wrist) the indices of successful free throws did not change statistically significantly ($p > 0.05$), but in the second group who concentrated on the external factor (the front part of the basketball hoop) the indices of successful free throws statistically significantly improved ($p < 0.05$) compared to the beginning of learning. Comparing the indices of accurate free throws in the second testing, we established significant difference between the average indices of both groups ($p < 0.05$). After the second testing both groups changed learning conditions. After the second testing, when the subjects changed the concentration tasks, the accuracy indices in the third testing were as follows: 83.0% (24.9 ± 1.6 accurate free throws) for the first group who learnt to focus on the external factor, and 76.7% (23.0 ± 1.4 accurate free throws) for the second group who learnt to focus on the internal factor. The third testing results showed that the number of successful free throws in the first LAPE group statistically significantly increased ($p < 0.05$) compared to the first and the second testing; however, the number of successful free throws in the second LAPE group statistically insignificantly ($p > 0.05$) decreased compared to the second testing. During the third testing we received statistically significant difference ($p < 0.05$) between the average indices of free throws of groups.

3.3. Study III. *Effect of special aid – shooting strap – on the accuracy of free throws for skilled female basketball players*

Indices of testing the accuracy of free throws. After the evaluation of accuracy indices of free throws in all three groups, we found that they did not differ statistically significantly ($p > 0.05$) during the first testing: 74.5 ± 3.4% in the experimental group of LAPE basketball players, 74.1 ± 2.1% in the experimental group of Lithuanian youth national team basketball players, and 76.2 ± 4.3% in the control group basketball players (Figure 3.3.1.).



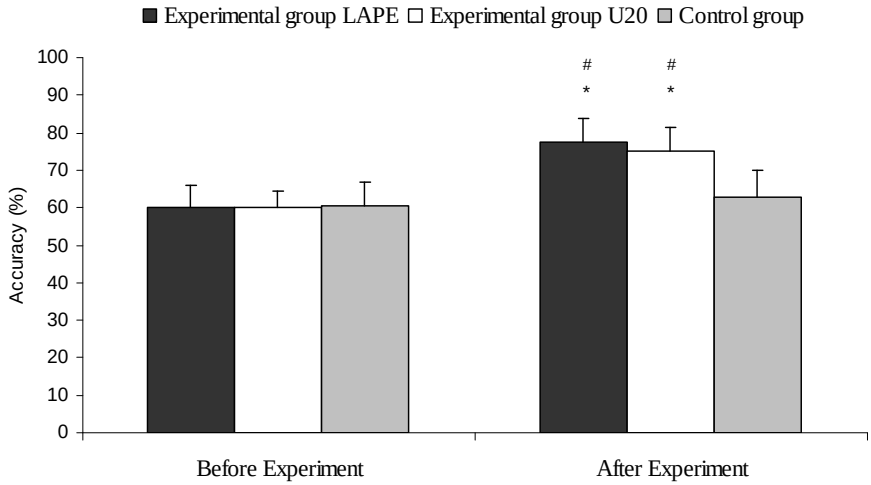
Note. * – $p < 0.05$, compared to the mean value of the first testing;
– $p < 0.05$, compared to the indices of the control group

Figure 3.3.1. **The accuracy indices of free throws for female basketball players before the experiment and after it (performing a test of 100 free throws)**

During the second testing, the accuracy of free throws was 88.2 ± 4.6% for LAPE subjects, 85.2 ± 5.5% for Lithuanian youth national team subjects and 77.5 ± 4.7% for control subjects who learnt free throws without any special aids. The second testing results showed that the accuracy of free throws in both experimental groups of LAPE basketball players and of Lithuanian youth national team basketball players statistically significantly improved ($p < 0.05$) compared to the indices in the first testing, but the accuracy indices in the control group did not change statistically significantly ($p > 0.05$). In the second testing we found statistically significant differences in the average accuracy indices of free throws between experimental groups and the control group ($p < 0.05$).

Retention of a free throw skill and its transfer to contest situation. The analysis of the accuracy of free shots during the matches before the experiment showed that the efficiency of free throws in a match was: 59.9 ± 6.1% for the experimental group of LAPE basketball players, 60.1 ± 4.5% for the

experimental group of Lithuanian youth national team basketball players, and 60.3 ± 6.5% for the control group basketball players (Figure 3.3.2.). Comparing the indices of accurate free throws before the experiment, we did not establish any significant difference between the average indices in both groups ($p > 0.05$).



Note. * – $p < 0.05$, compared to the obtained indices before the experiment;
– $p < 0.05$, compared to the indices of the control group

Figure 3.3.2. **The accuracy indices of free throws for female basketball players during matches before the experiment and after it**

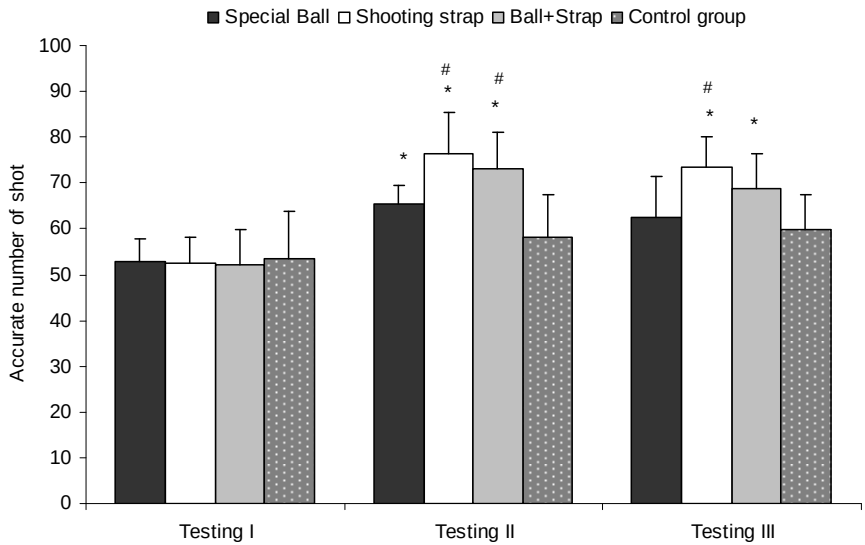
After teaching the indices of accurate free throws in a match were: 77.3 ± 6.4% for the experimental group of LAPE basketball players, 75.2 ± 6.4% for the experimental group of Lithuanian youth national team basketball players, and 62.8 ± 7.2 % for the control group basketball players. After one month of the application of a special shooting strap the indices of accurate free throws in a match showed that the accuracy of free throws in a match in both experimental groups (of LAPE basketball players and of Lithuanian youth national team basketball players) statistically significantly improved ($p < 0.05$) compared to the indices before the experiment, but in the

control group it did not change ($p > 0.05$). We found a statistically significant difference in the indices of the accuracy of free throws between experimental and control groups ($p < 0.05$).

3.4. Study IV. *Effect of the application of special shooting aids on the accuracy of free throws for young female basketball players*

Evaluation of the accuracy of free throws before the experiment. During the first testing (100 free throws) the efficiency of free throws of young basketball players (aged 14–15) was as follows: in the first experimental group who learnt free throws with a special training ball it was 52.8 ± 5.1%, in the second experimental group who learnt free throws with a special shooting strap it was 52.5 ± 5.7%, in the third experimental group who learnt free throws with both a special training ball and special shooting strap it was 52.3 ± 7.4%, and in the fourth – the control group – of basketball players it was 53.5 ± 8.4%. We found no significant differences in the mean indices of accuracy between all those groups ($p > 0.05$) during the first testing (Figure 3.4.1.).

Evaluation of the accuracy of free throws after the experiment. In all three experimental groups the accuracy indices of free throws were statistically significantly higher after the experiment than before the experiment ($p < 0.05$). The second testing showed that the accuracy indices of free throws improved by 65.3 ± 4.1% in the experimental group who learnt free throws with a special training ball, by 76.4 ± 8.9% in the second experimental group who learnt free throws with a special shooting strap, and by 73.2 ± 7.7 % in the third experimental group who learnt free throws with both a special training ball and special shooting strap. In the control group it improved buy 56.3 ± 9.1 %. We found statistically significant improvement in the accuracy of free throws in the experimental groups compared to the control group ($p < 0.05$). We also found statistically significant change in the accuracy of free throws between the groups: the accuracy of free throws in the group who learnt free throws only with a special training ball was statistically significantly lower than the one in the experimental groups ($p < 0.05$).



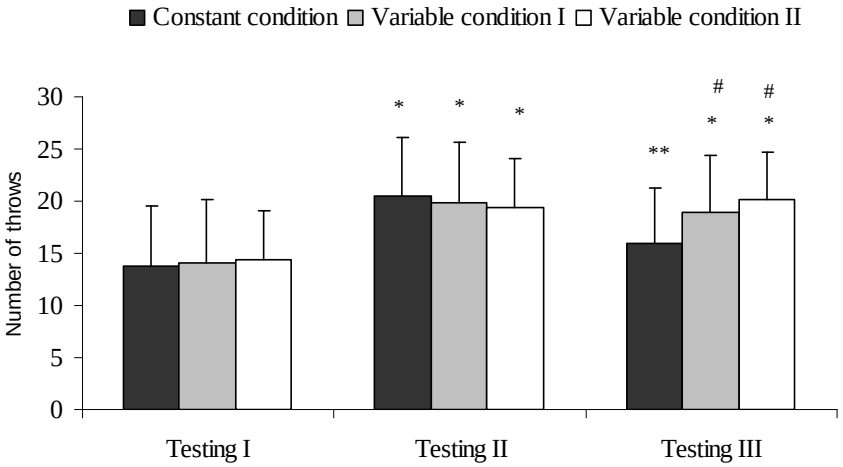
Note. * – $p < 0.05$, compared to the mean value of the first testing;
– $p < 0.05$, compared to the mean value of the control group
and the experimental group (balls)

Figure 3.4.1. **The accuracy of young female basketball players before the experiment (testing I), after the experiment (testing II) and after 7 months (testing III) performing a test of 100 free throws**

Evaluation of the accuracy of free throws 7 months after the experiment. In two experimental groups (with a special shooting strap and with both special aids), the accuracy of free throws 7 months after learning remained statistically significantly better compared to the beginning of learning ($p < 0.05$), and significantly unchanged compared to the end of learning ($p > 0.05$). The accuracy of free throws for basketball players in the experimental group who learnt free throws with a special training ball decreased with time, but not statistically significantly ($p > 0.05$). Skill retention indices in the control group did not change during that period of time ($p > 0.05$). After 7 months of learning retention of skills was better for the group who trained with both special aids compared to the group who trained only with a training ball and the control group ($p < 0.05$).

3.5. Study V. *Effect of the application of variable learning conditions on the accuracy of free throws*

Accuracy indices of free throws before the experiment. The analysis of the effect of the application of variable learning conditions on the accuracy of free throws showed that during the first testing the accuracy of free throws among the groups was as follows: under constant learning condition it was 46.0 ± 18.6%, under variable learning conditions with a well known sequence of movements – 46.7 ± 19.7%, under variable learning conditions with an unpredictable sequence of movements – 47.7 ± 15.9%. In the first testing we did not find any statistically significant differences in the indices of accuracy of free throws between the groups ($p > 0.05$) (Figure 3.5.1.).



Note. * – $p < 0.05$, compared to the indices of testing I;
– $p < 0.05$, compared to the indices of testing III under the conditions of continuous learning; **– $p < 0.05$, compared to the indices of testing II under the same learning conditions

Figure 3.5.1. **The indices of testing free throws before learning (testing I), after learning (testing II) and after a three-week break (testing III) performing a test of 30 free throws**

Accuracy indices of free throws after the experiment. Due to learning, free throw indices in all three groups during the second testing statistically significantly improved ($p < 0.05$) compared to the first testing: the accuracy of free throws in the constant learning group improved by 22.3 ± 5.6%, in the group of variable learning but when the sequence of movements was familiar – by 19.3 ± 5.8%, and in the group of variable learning with unpredictable sequence of movements – by 17.0 ± 4.6%. During the second testing we did not find any statistically significant differences between the groups tested ($p > 0.05$).

Accuracy indices of free throws three weeks after the experiment. After three weeks the subjects took a retention test (the third testing). Skill retention indices of those who learnt under constant conditions statistically significantly decreased ($p < 0.05$) compared to the end of learning. Skill retention indices of those who learnt under variable conditions with familiar sequence of movements decreased compared to the end of learning, but they improved when the subjects learnt under variable conditions with unpredictable sequence of movements. However, there were no statistically significant differences ($p > 0.05$). The comparison of retention indices when the skills were acquired under different learning conditions showed that the retention of skills was much better in those groups where the subjects learnt under variable learning conditions compared to constant learning conditions ($p < 0.05$). We found a statistically significant change in the retention indices (in both groups) compared to the beginning of learning ($p < 0.05$), but the retention indices in the group of constant learning did not essentially differ ($p > 0.05$).

4. DISCUSSION

Effect of application of preparatory movements and actions before a free throw on the accuracy of free throws. In individual tasks, such a performing a free throw in basketball, preparatory actions and movements as well as their sequence, efficiently affect the accuracy of free throws for young female basketball players (Wrisberg, Pein, 1992; Mack, 2001; Czech et al., 2004; Lidor, 2007). We found that the accuracy of free throws of young basketball players who had learnt the sequence of preparatory movements and actions according to the methodology of Amberry (1996) improved by 9%, when the accuracy of free throws in the control group remained unchanged. While using preparatory movements, athletes carry out their individual plans of actions before starting the performance of their task (Lidor, 2007). During preparatory actions and movements you can imagine yourself successfully performing the task, think about your movements and rehears what you have to perform (Boutcher, Crews, 1987; Boutcher, 1990; Lidor, Singer, 2003). The necessary condition for the quality of performance is the constant sequence of movements and actions that should be performed (Crew, Boutcher, 1986). Besides, athletes can maintain their attention concentration before performing an action during the performance of it, and they can better cope with internal (e.g. negative thoughts) and external (e.g. noise) interference (Boutcher, 1990; Moran, 1996); they can develop a feeling that they optimally control what they are doing. We have established that preparatory movements and actions of young female basketball players mostly affect the first free throw, which proves the efficiency of preparatory actions. However, the sequence of applied preparatory actions negatively affected the first free throw of skilled and experienced female basketball players: the old “habit” was broken, and the new one was not internalized yet. Lidor (2007) suggests that skilled basketball players who use their usual preparatory actions for a free throw should better keep away from the suggested changes in the sequence of actions and time. It has been established that changes in the preparatory movements and actions for a free throw as well as their sequence negatively affect the accuracy of shooting for a long time. Our research revealed that one month of learning

preparatory movements, actions and their sequence appeared to be efficient for the accuracy of free throws for young (aged 14–15) female basketball players, but this period was too short to change the sequence of preparatory actions for more experienced players.

Effect of attention concentration before a free throw on the accuracy of free throws. We established that attention concentration of young female basketball players to both external and internal factors did not affect the accuracy of throws. Many specialists (Wright, 2004; Mullaney, 2005; McGee, 2007; Wissel, 2010) suggest in their research papers that for beginners in basketball attention concentration is not a decisive factor for the accuracy of throws as they have not acquired the necessary shooting technique. According to Skurvydas (2008), if athletes have to perform a movement fast and accurately, at the beginning of learning they have to concentrate their attention to the accuracy of movement. Attention concentration becomes important only after acquiring correct shooting technique. Our research results showed that one month of learning for skilled basketball players, attention concentration on the external factor (the front part of the basketball hoop) significantly affected the accuracy of free throws, but attention concentration on the internal factor (the final movement of the wrist) did not have any significant effect. This confirms the fact that planning actions and concentrating attention on one factor which is linked to the task and is external is a very effective action (Martens, 1999, 2004). However, Vickers (1996c; 2007) suggests that many basketball players aim at the centre of the front part of the basketball hoop, though other places are also effective, e.g. the middle of the hoop, the middle of the back rim, or the centre of the board, and it is not important where the attention is concentrated, the main thing is that the target is the place where the attention is concentrated.

Effect of the application of a special aid – a shooting strap – on the accuracy of free throws for skilled basketball players. Our research results showed that in the experimental groups, where the players learnt to perform free throws using a shooting strap, the shooting accuracy indices after learning increased: by 13.7 ± 3.5% for LAPE basketball players and by 11.1 ± 2.4% for Lithuanian youth national team female basketball players. If you want to change a skill, you need to stop certain activity processes in the cortex of the

human brain and practically form a new skill, but the stability of dynamic stereotype in the cortex of the human brain is destroyed with difficulty. New motor activities should be based on firm and correct skills (Vilkas, 2006; Skurvydas, 2008). Aiming at modifying incorrect skills into new correct ones, it is recommended to apply various supportive technical aids intended for teaching and improving shooting (Palubinskas, 2004; Sowders, 2006; Wolf, 2006; Coryatt, 2007; Vann, 2010). It is worth noting that the retention of the skills and its transfer into contest activities were positively affected under stressful (match) conditions. After learning the accuracy of free throws during a match improved in both experimental groups by $17.4 \pm 4.0\%$ and $15.1 \pm 6.8\%$ respectively. In the control group, the indices of accuracy of free throws during the practice sessions and matches did not change statistically significantly. The variability of accuracy indices of our subjects after the experiment conforms to the findings of other authors about the effect of a shooting strap. We established that aiming at changing the incorrect technique of shooting it is necessary to practice at least one month, no less than three times a week performing 100 shots with a shooting strap. Besides, the application of this supporting aid has a residual value – the learnt skill was transferred and used in a contest situation.

Effect of application of special shooting aids on the accuracy of free throws for young female basketball players. The evaluation of free throw accuracy of young (aged 14–15) basketball players before the experiment and the comparison of them with the leading free throw accuracy indices of basket ball players of the same age which are reported in research literature (Stonkus, 2002) showed that the subjects conformed to the average evaluation of free throw accuracy. Research results showed that during fifteen practice sessions with special aids (training balls, shooting straps), the average indices of accuracy in free throws significantly improved: by $12.5 \pm 4.6\%$ for those who learnt with a special training ball and by 23.9 ± 4.0 for those who learnt with a shooting strap and by $20.9 \pm 3.7\%$ for those who used both supporting aids. The accuracy indices of free throws in the control group during this period improved by $4.8 \pm 2.3\%$. After learning the accuracy indices of young female basketball players compared to a very high evaluation (Stonkus, 2003). On the basis of practical research, Amberry (1996), Palubinskas (2004), Wolf (2006)

claim that non-specific special aids (shooting straps, special balls) guarantee correct skills of free throws and the stability of those skills. Our subjects learnt to perform free throws with special aids for a month, no less than three times a week, performing 100 throws during a practice session. Our results obtained in the experimental group confirmed the conclusion of Wolf (2006) that the position of the hand in a shooting strap has a great effect on the stability and accuracy of the shooting movement. The highest accuracy was achieved in the group which learnt shooting using a special shooting strap. We expected the experimental group who learnt using both supporting aids to produce the highest results. Though the indices in this group improved statistically significantly, the efficiency was not so good compared to the group who learnt using only the shooting strap. Effective but not the best results were obtained by the group who learnt free throws with a special training ball. Though the accuracy of free throws improved in all three groups of subjects, the shooting accuracy of the group who learnt free throws with a shooting strap improved statistically significantly more compared to the group who trained with a special ball. The data of the experiment suggest that one month of training (16 practice sessions, 100 shots in each) with special supporting aids is an effective means of the development of accuracy in free throws.

Effect of variable learning conditions on the accuracy of free throws. Research results showed all groups of subjects, learning under different conditions, improved their accuracy in free throws ($p < 0.05$) after five weeks of practicing. Our research data conform to the data of Shoenfelt and co-authors (2002) who experimented with male basketball players for three weeks. The accuracy of free throws in the research by the authors mentioned above improved by 5.2%. Erffmeyer (1988) applied the improvement program of free throws for university basketball players for six weeks where the players trained under variable conditions, and their accuracy improved by 8.1%. The subjects in the stable learning group trained under stable conditions which conformed to the task (performing free throws), but they did not show any higher results compared to those who learnt under variable conditions. It is worth noting that the claims of supporters of stable learning conditions did not confirm. They claimed that constant conditions were more advantageous for the performance of identical movements as this would increase retention and

automation of movements (Adams, 1976; Anderson, 1982, 1995). Supporters of variable learning suggest that in the skill acquisition phase (during the practice session), the results of players practicing under variable conditions may appear to be worse compared to those players who practiced under constant conditions, but players practicing under variable conditions should produce better results in the period of retention (Schmidt, Bjork, 1992; Magill, 2007; Schmidt, Wrisberg, 2007). The results obtained by the subjects confirmed the theory that in retention tests better results are produced by learners who train under variable conditions. In the test of later retention the accuracy indices of free throws in variable groups were similar, but they significantly decreased for the players who learnt under constant conditions. The players who learnt under complex variable conditions – unpredictable sequence of movements – demonstrated similar results in practice sessions and in testing, and their testing results were similar to those produced by players who learnt under different conditions. Such conditions as unpredictable sequence of movements can cause the decrease in indices, but they can also produce better indices in the retention test when the skill needs to be used in various conditions (Schmidt, Bjork 1992; Ghodsian et al., 1997; Farrell, McDaniel, 2001). We suppose that if the experiment lasted longer and the retention test was taken after a longer period of time, variable learning conditions could have proved to be the most advantageous training method. On our research we established that variable training conditions were more appropriate for learning free throws, though the conditions of the application of that skill are constant.

CONCLUSIONS

1. Systemic sequence of thoughts and actions linked to the task, which is performed before the beginning of a specific athletic action – a free throw, improved the accuracy of the technical action for young female basketball players. Changing the sequence of already learnt preparatory movements and actions into a sequence of new actions did not have a positive effect on the accuracy of free throws for skilled female basketball players. The application of those actions becomes important before the first free throw, and after learning the accuracy of this throw statistically significantly improved.

2. Attention concentration, focusing attention to specific external factor (the front part of the basketball hoop) before carrying out an independent movement – a free throw – improved the accuracy of free throws for skilled female basketball players, and attention concentration to the internal factor (the final movement of the wrist) did not have a positive effect on the accuracy of free throws. For young basketball players, attention concentration both to external and internal factors did not have any positive effect on the efficiency of throws or the stability of movements.

3. Application of special supporting aids for shooting – a shooting strap – for the development and consolidation of a correct free throw skill is effective. While improving the individual technical skill with the help of this aid, the position of holding and throwing the ball improved, so even in the third practice session the stability of shooting movements and the accuracy of free throws for skilled female basketball players statistically significantly improved. The application of a special shooting strap for the enhancement of the correct skill in the practice sessions was efficient for the retention of the skill and its transfer into contest situations.

4. Application of special supporting aids for shooting (special training ball and shooting strap) had a positive effect on the free throw accuracy for young female basketball players. Using a special training ball or both aids at one time did not have as efficient for the stability of movement and its retention as using the shooting strap alone. Application of special aids significantly improved the situational indices of shooting: the number of

accurate shots increased, and the number of successful shots from the right or the left parts of the basketball hoop decreased.

5. A free throw is a constant technical action, and it is performed under constant conditions. Both constant and variable learning conditions affected the accuracy of technical actions while learning free throws. Skill retention was better for those subjects who learnt under variable conditions, but it significantly decreased for those who learnt under constant conditions. The greatest change in learning was achieved during the first five practice sessions.

SANTRAUKA

Temos aktualumas. Krepšinis – tai sportinis dviejų komandų po penkis žaidėjus žaidimas aikštėje varant, perduodant vienas kitam ir metant kamuolį į varžovų komandos krepšį. Krepšinio tobulėjimas yra tiesiogiai susijęs su viena iš svarbiausių problemų, kylančių žaidėjams, treneriams bei mokslininkams – metimų ir baudos metimų tikslumo gerinimu (Nemeth, 2002; Stonkus, 2003; Emma, 2004; Sivils, 2010; Filippi, 2011). Pagrindinio technikos veiksmo žaidžiant krepšinį – kamuolio metimo į krepšį efektyvumo priklausomybė daugialypė: metimų tikslumą žaidžiant lemia biomechaniniai žaidėjo atliekamo veiksmo rodikliai (Brancazio, 1981; Hudson, 1985; Miller, 2002; Fontanella, 2007; Bartlett, 2008), judesių stabilumas (Millslagle, 2002; Button et al., 2003; Okubo, Hubbard, 2006; Bartlett et al., 2007; Lam et al., 2009), organizmo gebėjimas prisitaikyti prie įvairaus intensyvumo ir pobūdžio fizinių krūvių (McInnes et al., 1995; Ziv, Lidor, 2009; Mongomery et al., 2010), psichinės savybės (Burke, Brown, 2002; Vealey, Greenleaf, 2006; Malinauskas, 2010).

Metimų rodiklių kaitą rungtynių metu lemia aktyvūs varžovų gynybos veiksmai, taikomos gynybos sistemos, žaidėjų fizinė bei psichinė būklė, atsižvelgiant į rungtynių svarbą, jų rezultatą. Baudos metimo tikslumui išskirtinį poveikį daro rungtynių rezultatas ir su juo susijusi atliekančio metimą krepšininko psichinė būklė (Stonkus, 2003; Wissel, 2011). Nustatyta, kad baudos metimai sudaro 20–25 proc. visų per rungtynes pelnytų taškų (Kozar et al., 1994), todėl šių metimų tikslumas turi lemiamą poveikį siekiant pergalės (Karipidis et al., 2001; Sampaio, Janeira, 2003; Csataljay et al., 2009; Kreivytė, Čižauskas, 2010; Zuzik, 2011). Dideliu aktyvumu baigiant atakas ir baudos metimų tikslumo stabilumu pasižymėjo 1997 m. Europos čempione tapusi Lietuvos moterų krepšinio rinktinė – ji per vienerias čempionato rungtynes mesdavo vidutiniškai po 28 baudos metimus, iš jų 22 būdavo tikslūs (tikslumas 79 proc.), o tai sudarė 29 proc. visų pelnytų per rungtynes taškų (Čižauskas, Kreivytė, 2004). Tyrimais nustatyta, kad vidutinis geriausiųjų pasaulio krepšinio žaidėjų (vyrų ir moterų) baudos metimų tikslumas per rungtynes sudaro 76 proc. Metimų tikslumas, kuris siekia 65 proc., laikomas mažu, o geriausių metikų tikslumas per rungtynes sudaro 90 proc. ir daugiau (Vickers,

2007, pagal www.nba.com). Remiantis judesių valdymo klasifikacija (McMorris, 2004; Schmidt, Wrisberg, 2007; Schmidt, Lee, 2011) baudos metimas išskiriamas kaip uždaras savarankiško tempo veiksmas, kadangi atlikti šį veiksmą varžovai netrukdo (Singer, 2000; Lidor, 2007).

Daugelis mokslininkų (Lobmeyer, Wasserman, 1986; Wrisberg, Pein, 1992; Mack, 2001; Czech et al., 2004; Gooding, Gardner, 2009) aiškina, kad judesio tikslumas daug priklauso nuo pasirengimo atlikti veiksmą – parengiamosios fazės. Prieš mesdami baudos metimą krepšininkai atlieka **parengiamuosius judesius, veiksmus**, kurie literatūroje apibūdinami kaip sistemiška motorinių, emocinių ir kognityvinių elgsenų seka prieš pat pagrindinio veiksmo vyksmą (Kingston, Hardy, 2001; Lidor, Mayan, 2005). Nustatyta, kad įgudusių krepšininkų atliekami parengiamieji judesiai, veiksmai teigiamai veikia baudos metimų tikslumą (Singer, 2002; McMorris, 2004), tačiau nėra aišku, kaip šie judesiai, veiksmai veikia pradedančiųjų krepšininkų metimų tikslumą. Pagal FIBA taisykles baudos metimui pasirengti skiriamos 5 sek., todėl parengiamieji veiksmai yra labai individualūs ir kiekvieno žaidėjo kitokie (Boutcher, 1990; Cohn, 1990; Moran, 1996; Lidor, Singer, 2003). Literatūroje pateikiama nemažai metodų, kaip atlikti parengiamuosius judesius prieš metant baudą (Amberry, 1996; Wissel, 2005; 2011; Filippi, 2011), tačiau Wrisberg ir Pein įsitikinę (1992), kad krepšininkai turėtų patys susikurti tinkamiausius parengiamuosius judesius, veiksmus ir jų seką prieš baudos metimą.

Daugelis mokslininkų (Al-Abood et al., 2002; Singer, 2002; Lidor, Singer, 2003; Wulf et al., 2005; Zachry et al., 2005; Chiviacowsky, Wulf, 2007; Wulf, 2007 a, b) pabrėžia **dėmesio sutelkimo** svarbą prieš atliekant savarankišką veiksmą. Varžybų aplinkoje, jei nesusitelkta į specialaus veiksmo atlikimą, dėmesys gali būti blaškomas žiūrovų triukšmo, judėjimo šalia aikštės ir panašių dirgiklių (Martens, 1999, 2004; Malinauskas, 2010; Weinberg, Gould, 2010). Dėmesį galima sutelkti **į vidų** (**vidinius veiksnius**) ir **į išorę** (**išorinius veiksnius**). Į vidų nukreiptas dėmesys – tai dėmesys į atliekamo judesio detales, pvz.: rankas, amplitudę, greitį; į išorę nukreiptas dėmesys – tai dėmesys į galutinį judesio tikslą ir/ar aplinką. Šiuo metu mokslininkai vis dažniau rekomenduoja sutelkti dėmesį į judesio išorę (Skurvydas, 2008).

Parengiamieji judesiai, veiksmai bei dėmesio sutelkimas į išorinį veiksnį

metant baudos metimą negarantuoja judesio stabilumo ir tikslumo, jeigu jau yra susiformavęs klaidingas technikos veiksmo atlikimo įgūdis (Sowders, 2006; Vann, 2010). Kad pakeistume įgūdį, būtina sustabdyti ankstesnės veiklos vyksmą ir formuoti naują įgūdį (Vilkas, 2006). Norint įtvirtinti naujus taisyklingus metimo įgūdžius bei siekti geriausių sportinių rezultatų rekomenduojama taikyti įvairias **pagalbines ir netradicines technikos priemones** (tai specialūs įtvarai, mokomieji kamuoliai), **įrenginius** (sumažinti lankai, stovai metimo trajektorijai tobulinti), kurios turi įtakos metimo veiksmo ir jo dalių (judesių) stabilumui bei tikslumui (Foley, 2005; Coryatt, 2007; Heystek, Atwood, 2010; Moye, 2011). Wolf (2006) pažymi, kad mokantis metimų viena ranka nuo peties ir tobulinant jų techniką su **specialiu kamuolį prilaikančios rankos įtvaru** išsiugdoma taisyklinga rankų padėtis laikant bei išmetant kamuolį ir tinkamiausia nepagrindinės rankos padėtis. Palubinskas (2004) nustatė, kad metimo tikslumas taip pat priklauso nuo plaštakos padėties ant kamuolio, ir remiantis autoriaus rekomendacijomis buvo sukurtas **specialus mokomasis kamuolys**, padedantis metimo metu fiksuoti tikslią metamosios rankos, jos pirštų padėtį, t. y. tinkamai suformuoti ir įtvirtinti pastovius tos rankos ir pirštų judesius išmetant kamuolį (kamuolio atsiskyrimo nuo rankos momentu).

Nors ir sukurta pagalbinių priemonių (specialūs įtvarai, mokomieji kamuoliai), padedančių gerinti metimo veiksmingumą, tačiau sporto mokslo pasaulyje šia tema dar nėra atlikta tyrimų ir publikuota darbų, todėl mūsų tyrimo duomenys bus nauja informacija tiek mokslo specialistams, tiek treneriams praktikams.

Baudos metimų tikslumas per pratybas ir rungtynes skiriasi: per pratybas krepšininkai atlieka baudos metimus tiksliau. To priežastis gali būti skirtingos baudos metimų sąlygos: per pratybas žaidėjai meta baudos metimus serijomis (pvz., po dešimt), per rungtynes – po du, kartais po tris. **Pastovios pratybų sąlygos** padeda įvaldyti judesį, o po kurio laiko jis bus atliekamas automatiškai (Adams, 1987; Ackerman, 1988); **kintamos pratybų sąlygos** leidžia žaidėjui geriau prisiminti įgūdį, ypač kai vėliau jį tenka pritaikyti dinamiškomis žaidimo situacijomis (Schmidt, 1975; Schmidt, Wrisberg, 2007; Skurvydas, 2008). Todėl per pratybas įgūdžiams, kurių pritaikymo situacijos nekinta, naudojamos pastovios sąlygos, o tiems įgūdžiams, kurių pritaikymo

situacijos varijuoja, naudojamos kintamos sąlygos. Aptikta tyrimų, kurių išvadose teigiama, jog kintamos pratybų sąlygos gali būti naudingesnės netgi ugdant įgūdžius, kurių pritaikymo situacijos nekinta (Ghodsian et al., 1997).

Nustatant ir vertinant pagrindinio krepšinio technikos veiksmo – metimo tikslumo pastovumą negalima pasikliauti vien tik rungtynių rezultatais. Nustatyti konkrečius baudos metimų tikslumo reikalavimus krepšininkams galima tik turint tiesioginiais tyrimais, matavimais gautus objektyvius žaidimo situacijomis arba artimomis žaidimui situacijomis rodiklius (Miller, Bartlett, 1996; Stonkus, 2003; Balčiūnas, 2005).

Lietuvos krepšinio rinktinės žaidėjų, komandų (įvairaus amžiaus grupių) baudos metimų tikslumas gerokai atsilieka nuo komandų, Europos bei pasaulio čempionatuose užėmusių prizines vietas (Kreivytė, Čižauskas, 2007). Ne itin didelis baudos metimų tikslumas per rungtynes, palyginti su tokių metimų tikslumu per pratybas, verčia ieškoti parankių metodų bei priemonių baudos metimų tikslumui efektyvinti. Nustatyta, kad paauglystėje (12–15 metų amžiuje) tobulėja sudėtingesnės koordinacijos motoriniai gebėjimai (Prudden, 2006; Skurvydas, 2008) ir svarbiausi žaidėjo techninio parengtumo požymiai – tai veiksmo stabilumas ir tikslumas (Balčiūnas ir kt., 2009; Sivils, 2010; Filippi, 2011), todėl susipažinus su metimų technikos, jos stabilumo bei tikslumo priklausomybės tyrimais ir suvokiant teorinę bei praktinę tokių tyrimų ir jų išvadų reikšmę tampa **aktuali mokslinė problema: kokį poveikį turi parengiamieji judesiai, dėmesio sutelkimas, pagalbinės technikos priemonės, pastovios ir kintamos mokymo sąlygos jaunųjų bei patyrusių krepšininkių baudos metimų tikslumui?**

Tyrimo tikslas: nustatyti skirtingų mokymo(si) metodikų bei pagalbinių priemonių taikymo poveikį baudos metimų tikslumui.

Tyrimo uždaviniai:

1. Nustatyti parengiamųjų judesių, veiksmų metodikos poveikį baudos metimų tikslumui.
2. Nustatyti dėmesio sutelkimo metodikos poveikį baudos metimų tikslumui.
3. Nustatyti specialios metimo priemonės – kamuolį prilaikančios rankos įtvaro poveikį patyrusių krepšininkių baudos metimų tikslumui.
4. Nustatyti specialių pagalbinių metimo priemonių (specialių

mokomųjų kamuolių, kamuolį prilaikančios rankos įtvarų) poveikį jaunųjų krepšininkių baudos metimų tikslumui.

5. Nustatyti skirtingų mokymosi sąlygų (pastovių ir kintamų) poveikį baudos metimų tikslumui.

Disertacinio darbo originalumas

Tyrimo rezultatai parodė, kad parengiamųjų judesių, veiksmų taikymas prieš atliekant savarankišką veiksmą – baudos metimą ypač veiksmingas jaunosioms krepšininkėms, tačiau šių veiksmų sekos pakeitimas jau patyrusioms krepšininkėms nėra veiksmingas. Nustatyta, kad atliekant savarankišką technikos veiksmą dėmesio sutelkimas į išorinį veiksnį (priekinę krepšio lanko dalį) jaunosioms krepšininkėms nėra toks svarbus kaip patyrusioms krepšininkėms. Neįgudusioms sportininkėms atliekant savarankišką technikos veiksmą pirmiausia reikia pajusti, suvokti judesio visumą ir labiau sutelkti dėmesį į judesio tikslumą. Netaisyklingam baudos metimo įgūdžiui pakeisti ir naujam taisyklingam sukurti, įvaldyti bei įtvirtinti paranku taikyti specialias pagalbines priemones. Paaiškėjo, kad veiksmingiausia pagalbinė priemonė gerinant baudos metimų techniką – specialus kamuolį prilaikančios rankos įtvaras. Jo taikymas reikšmingai pagerino tiek patyrusių, tiek jaunųjų krepšininkių baudos metimų tikslumą. Svarbu tai, kad ši pagalbinė priemonė padeda atsiminti įgūdį po ilgo laiko ir perkelti jį į varžybų situacijas. Specialių pagalbinių priemonių taikymas padėjo išmokti taisyklingai laikyti kamuolį prieš atliekant metimą, išmetimo metu ir sumažino situacinius kamuolio „kraipymosi į šalis“ rodiklius krepšio lanko atžvilgiu. Nustatyta, kad užduočių, kurių pritaikymo sąlygos beveik nekinta, atlikimo tikslumas pagerėjo treniruojantis tiek pastoviomis, tiek kintamomis mokymo(si) sąlygomis, tačiau kintamų sąlygų per pratybas pranašumas išlieka prisimenant įgūdį. Manytina, kad visa tai neabejotinai papildo krepšininkų sportinio rengimo teoriją ir metodiką, ypač tas dalis, kurios yra susijusios su judesių mokymu.

Teorinė ir praktinė disertacinio darbo vertė

Tokio tyrimo rezultatai, siejami su teoriniais mokymais bei jų taikymu praktikoje, gali suteikti gana vertingą informaciją, kuri būtina modeliuojant krepšininkų rengimo metodiką, leidžiančią padidinti pratybų kokybę, kartu pagerinti žaidimo rezultatyvumą per rungtynes. Šio tyrimo duomenys taip pat

gali būti naudingi mokant vaikus kaskart naujų metimo įgūdžių bei tobulinant didelio meistriškumo sportininkų metimų technikos veiksmus. Manytina, kad pasitelkus netradicines pagalbinių mokymo(si) priemonių taikymo metodikas gauti tyrimo duomenys ir padarytos išvados turės ne tik teorinę, bet ir praktinę reikšmę gerinant įvairaus parengtumo krepšininkų metimų ir baudos metimų tikslumą.

IŠVADOS

1. Sistemiška su užduotimi susijusių minčių ir veiksmų seka prieš pradedant krepšinio technikos veiksmą – baudos metimą pagerino šio jaunųjų krepšininkių atliekamo veiksmo tikslumą. Jau išmoktų parengiamųjų judesių, veiksmų ir jų sekos pakeitimas nauja veiksmų seka neturėjo teigiamo poveikio patyrusių krepšininkių baudos metimų tikslumui. Parengiamųjų judesių, veiksmų taikymas buvo efektyvus atliekant pirmą baudos metimą, po mokymo šio metimo tikslumas reikšmingai padidėjo.

2. Dėmesio sutelkimas į specifinį išorinį veiksnį (priekinę lanko dalį) ir fiksavimas prieš atliekant savarankišką veiksmą – baudos metimą pagerino patyrusių krepšininkių metimų tikslumą, o dėmesio sutelkimas į vidinį veiksnį (baigiamąjį riešo judesį) teigiamo poveikio baudos metimo tikslumui neturėjo. Jaunųjų krepšininkių dėmesio sutelkimas į išorinį ar vidinį veiksnį taip pat neturėjo teigiamo poveikio metimų veiksmingumui bei judesių stabilumui.

3. Specialios pagalbinės metimo priemonės – kamuolį prilaikančios rankos įtvaro taikymas susidarant ir įtvirtinant taisyklingą baudos metimo įgūdį buvo veiksmingas. Tobulinant individualų technikos veiksmą su šia pagalbine priemone lavėjo mokėjimas taisyklingai laikyti bei išmesti kamuolį, todėl jau trečių pratybų metu reikšmingai pagerėjo patyrusių krepšininkių, atliekančių baudos metimus, judesių stabilumas ir metimų tikslumas. Specialaus įtvaro taikymas per pratybas įtvirtinant taisyklingą įgūdį buvo veiksminga priemonė įsimenant bei perkeliant įgūdį į varžybų situacijas.

4. Pagalbinių metimo priemonių (specialaus įtvaro bei mokomojo kamuolio) taikymas teigiamai veikė jaunųjų krepšininkių baudos metimų tikslumą. Specialaus mokomojo kamuolio, taip pat abiejų pagalbinių priemonių taikymas vienu metu nebuvo toks veiksmingas gerinant judesių stabilumą ir jų įsiminimą kaip specialus kamuolį prilaikančios rankos įtvaras. Abiejų pagalbinių priemonių taikymas ypač reikšmingai pagerino situacinius metimų rodiklius: padaugėjo labai tikslių metimų, sumažėjo metimų, kai kamuolys įkrinta į krepšį atsimušęs nuo dešinės ar kairės lanko dalies.

5. Baudos metimas yra pastovus technikos veiksmas, atliekamas nekintamomis sąlygomis. Mokantis baudos metimų reikšmingą poveikį

technikos veiksmo tikslumui turėjo tiek kintamos, tiek pastovios mokymo sąlygos. Įgūdžio įsiminimas išliko geresnis tų krepšininkų, kurie mokėsi kintamomis sąlygomis, tačiau šis rodiklis reikšmingai sumažėjo krepšininkų, kurie mokėsi pastoviomis sąlygomis. Didžiausias įgūdžio įvaldymo pokytis buvo pasiektas per pirmas penkerias pratybas.

APPROBATION OF RESULTS OF THE DOCTORAL DISSERTATION

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3. Koblinec, D., Kreivytė, R. (2009). Lyginamoji metimų į krepšį, esant įvairiam fiziniam krūviui, tikslumo rodiklių analizė. *Sporto mokslas*, 2 (56), 70–75.
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