

Improving university students' coordinating skills in physical education lessons with basketball focus

Cristina I. Nae^{ABCDE}, Cristiana L. Pop^{AD}

Bucharest University of Economic Studies, Romania

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Abstract

Background and Study Aim The purpose of the study was to examine the effectiveness of a 14-week intervention in improving coordination skills among female university students. The intervention consisted in physical education lessons with basketball focus, the final practical outcome being to practice a coherent and satisfying game for the players.

Material and Methods The research was carried out on a group of 15 female university students aged 19-20, in the second semester of the academic year 2018-2019, lasted 14 weeks, with a frequency of 1 lesson per week. The applied tests were dynamic balance, body coordination, hands coordination, basketball spot shooting, wall passes. Measurements were performed before intervention as a baseline and after it to record the effect size. The manipulated variable was a physical exercises program designed in purpose to produce an effect on the dependent variable: coordination skills improvement. The significant mean difference and the effect size was statistically demonstrated with student t-test $p < 0.005$.

Results From the statistical data obtained, we found that the results of 'before and after' tests differ significantly. For all the parameters under discussion the effect magnitude was large and mostly very large, also the research hypothesis was accepted.

Conclusions Applying the designed program has led to a substantial improvement of coordinating skills and has positively influenced the effectiveness of the basketball technique learning process.

Keywords: coordination skills, basketball, female students, test battery.

Introduction

Coordination is a complex, multidisciplinary concept and therefore its definition varies depending on the field of movement science approached. Furthermore, there are different points of view within the same discipline. In biomechanics, for example coordination is viewed as a synergic action of elements aiming to achieve a common task, or an interrelation of different elements not necessarily acting toward a common goal [1].

Coordinated movements represent a distinct category of instrumental movements, which give the subject the opportunity to economize effort, motor action, in predictable (stereotypical) and unpredictable situations [2]. Coordination skills underpin all motor skills, with a particular role in all kinds of situations that require athletes' rational and quick action [3].

In Physical Education, coordination skills are an important basis for correct learning and practice of high-level motor skills and leads to the fast adjustment of the subject in different work conditions specific to different sports, basketball in our case [4].

The term 'coordination skills' has been established in the 1980s [5-9] but for a long period of time, this concept has been used alongside

the terms: dexterity or a complex different skill combination.

Dexterity is defined as a complex form of expressing performance capacity [10] through the quick learning of new movements and fast adjustment to various situations, according to the specifics of each sport.

Because dexterity is a complex motor skill in its structure Colibaba & Bota [11] included:

- The precision of motor movements or mastery/controlled movement;
- Fine mental guidance of the muscular chains: agonist, antagonist, synergist and fixator muscle;
- Kinesthetic sense;
- Ball movement and awareness;
- Ability to approximate distances;
- Ability to mobilize mentally;
- Mental factors capable to influence the sportsman's motor behavior positively or negatively.

Coordination is defined as a complex capacity correlated with speed, strength, endurance, and mobility. From a physiological point of view, coordination is determined by genetic and environmental factors [12]. Coordination abilities depend highly on the efficient functioning of the central nervous system.

The level of coordination represents the ability

to execute movements having different degrees of difficulty, quickness, with great accuracy and high efficiency in accordance with the specific objectives of the training [13]. Of all the motor abilities, muscle strength affects execution speed, endurance and coordination skills [14, 15]. Concluding these definitions, we understand that coordination skills features are complexity, synergic action, and in the case of sporting games excelling under stress in challenging conditions.

Basketball has evolved significantly in terms of technique, tactics, requiring speed of play, and a high level of skilfulness. This evolution is due to the need of players to better solve the game concrete situations, in permanent dispute with the opponent [16] but also with the desire to overcome their physical limits.

In basketball, all basic factors of movement are part of the coordination skills in variable proportions – speed, force, resistance, eye – hand coordination, joint mobility, good sense of direction and other motor abilities [17]. The complex process of fast adaptation of the whole body to the game requirements have on its basis constant feedback between motor abilities, control, and level of fatigue.

In universities physical education classes, coordination skills can be exercised by using free or object-based exercises; practiced individually, in pairs or in teams. The exercises may be organized by means of relays, with ever-changing conditions and various difficulty levels.

The methodical steps needed to improve basketball-specific coordination skills and taken in physical education lessons may be:

- Ensuring the precision of technical procedures, as well as spatial orientation without regard to time; one evaluates the correctness of the movements done simultaneously with different parts of the body in order to perform the action;
- The correct and precise execution of all movements in order to perform technical procedures given in a short period of time;
- Performing movements in various and unusual situations, without mistake and while maintaining top speed. The entire process implies developing technical methods from a coordination point of view.

This study aimed at examining the effectiveness of a 14-week intervention in improving coordination skills among female university students. The intervention consisted in physical education lessons with basketball exercises, the final practical outcome being to practice a coherent and satisfying game for the players.

Materials and Methods

Participants

The research was carried out on a group of 15 female university students in first year in a faculty with economic profile, aged 19 ± 0.28 . The study began in the second semester of the academic year 2018-2019, lasted 14 weeks, with a frequency of 1 lesson per week. The inclusion criteria for eligible participation in the study group was that students have played basketball during their high school years.

Research design

The research design we considered relevant for our study was a pre-experimental one, with one group under intervention conditions [18]. Measurements were performed before intervention as a baseline and after it to record the effect size. The measurements were undertaken in the Bucharest University of Economic Studies' sport hall.

The manipulated variable was a physical exercises program designed in purpose to produce an effect on the dependent variable: coordination skills improvement. During the 14 lessons, the routine compiled:

Warming-up exercises:

- Walking or running exercises, alternated with power skips and bounding done in a certain rhythm
- Various running exercises, alternated with successive or isolated twirling
- From standing position: moving forward – backward with different arm movement for each step
- From standing position: raise on tiptoes, down on heels performed with different arm positions and movements
- Bending the torso in front and putting arms sideways
- From standing position, holding hands behind, tiptoe with eyes closed
- From standing position: left/right lunge while bringing left/right arm on the left/right shoulder behind the head, left/right arm sideways
- From standing position, arms up: four steps forward while rotating arms front-back at each step, four steps back with reverse rotation of arms
- Running over various obstacles with different heights, while maintaining the rhythm between two obstacles
- Rolling two balls, jumping from circle to circle, cone running drills – with cones placed at different positions and distances, with various combinations.

Lesson focus:

- From dribbling with left/right hand, the student throws the ball up in the air performs a 180° jump and then catches the ball before it hits the ground at the signal

- From pike position with the ball above ankles: the student throws the ball up with the feet and catches it in her hands;
- From slow running, dribble with left/right hand, guiding the ball around the body, then between the feet;
- Using two balls: throwing and catching the balls alternatively up or at the wall, as soon as the execution becomes better, balls can be thrown at the same time;
- Guiding the ball with the foot, while rotating the arms at the same time;
- With the back against the wall, holding a ball in the hands, throwing the ball at the wall from the hip area (or other ways of throwing), then face the wall and catch the ball;
- Exercises with multiple balls (passes and throwing at the hoop);
- Ambidextrous dribbling, passes and throws;
- Dribbling with two balls;
- Passes with both hands in front of the chest, both hands above the head, above the ear, with a hand on the shoulder, with a hand behind the back, shooting from the spot, then running and shooting while running;
- Perfecting dribbling during contra attack and during individual breaking-in and overrun – both ambidextrous;
- Complex exercises done on half the field and all over the field in order to perfect spot throwing at the hoop and while jumping;
- Catching the ball – stopping – dribbling – spot throwing at the hoop;
- Catching the ball – stopping – feint to throw – feint to overrun – dribbling – throw at the hoop;
- Catching the ball – stopping – feint – overrun with dribbling under the backboard – throwing with a hand;
- Going after the ball – catching – stopping – feint to throw – dribbling – stopping – feint to throw – throw at the hoop – rebound;
- Perfecting defending man to man, aggressive version and intercepting;
- Matches at the school level 5 against 5 on half the field and entire field.

Closing exercises

- Stretching exercises for flexibility improvement.
- The research instruments were a battery of test conducted at the beginning (T1) and at the end of the study (T2), besides the 14 lessons and had the following tasks:

1. Dynamic balance – on a reversed gymnastic bench, the student walks over the distance with two 180° twirls at the middle of the bench and continuing the walk. Any imbalance is marked down a point. Falling leads to repeating the task. The tasks are executed twice, scores are given and the best attempt is picked.

2. Body coordination – a grid is drawn on the field's surface, the students perform 3 connected jumps – these should be as long as possible.
3. Hand coordination – a 25/25 cm square is drawn on a wall at a 1.5 m height. From a 2 m distance the student throws five balls with the right hand and five balls with the left hand. For each target hit, the student receives a point.
4. Basketball spot shooting – from under the backboard with the skilful hand, 10 throws. The score of successful throws were considered.
5. Dribble and throw from the dominant hand side – they are given points from 1 to 10 for technical correctness, correct step sequence and scoring.
6. Wall passes drill – on the left-side wall 4 squares are drawn at a 1.5 m distance from the floor and on the right-side wall, 3 squares are drawn at an equal distance. The female student dribbles from the end of the hall towards the left-side wall, performs passes at the wall from a 3 m distance, then dribbles towards the right-side wall and performs a wall pass and repeats at all the 7 points. The task is timed.

Statistical Analysis

During our research, the data obtained through measurement and tests has been statistically processed and charted aiming the hypothesis validation through mean difference between pre and post-tests and determine the effect size using t-Test Dependent Student calculated for a statistical significance of $p < 0.05$ level. The effect size was compared with Cohen scale. In data analysis SPSS software was used.

Results

The results obtained before (I) and after (F) intervention at all 6 tasks were tabulated in Table 1.

The statistical processing data obtained can be seen in table 2. The most relevant results are presented. Among them are the progress percentage, the effect size and the t-Test results compared with the critical t value (2.14)

Discussion

The most recommended period for developing coordination skills is in childhood between 5 and 6 years of age and then in preadolescence between 10 and 13. However the highest values of coordination skills can be reached between 17 and 20 years of age. Following this idea, a number of studies have obtained good results in developing coordination abilities in samples of university students [19, 20]. It demonstrates that development of coordination abilities is an overgoing process.

After analyzing and interpreting the data presented in Table 2, we observe an important improvement in all final tests. The highest improvement percentage was observed in the Spot

Table 1. The results obtained

No.	Dynamic balance		Body coordination		Hand coordination				Basketball spot shooting (%)		Dribble and throw		Wall passes (sec.)	
	I	F	I	F	Right		Left		I	F	I	F	I	F
1	7	8	4.20	4.82	4	5	2	3	20	20	8	9	21	19
2	8	9	4.10	4.26	3	4	3	3	30	40	6	7	23	20
3	6	7	4.55	4.83	3	4	4	5	40	50	5	7	20	16
4	8	10	5.57	5.67	3	4	3	3	20	40	6	7	22	21
5	7	8	4.00	4.07	4	4	3	4	30	50	5	6	21	19
6	7	8	5.10	5.69	4	5	4	5	50	70	5	6	23	20
7	7	8	4.10	4.60	4	5	4	5	50	60	6	7	22	21
8	8	9	5.02	5.52	4	5	3	4	40	50	6	6	20	17
9	7	7	3.80	4.02	1	1	1	2	20	30	5	7	22	22
10	9	10	4.00	4.18	3	3	0	0	20	30	6	7	24	23
11	7	8	4.12	4.54	3	4	2	3	20	20	5	7	23	22
12	6	7	4.90	5.04	3	4	4	4	30	30	6	7	20	18
13	9	10	4.57	4.72	4	5	3	4	30	40	6	8	20	19
14	8	8	5.00	5.20	3	3	4	4	30	40	6	8	17	16
15	8	10	3.80	4.88	3	4	4	5	60	70	6	6	19	17

Table 2. Statistical processing data

Statistical indicators	Dynamic balance		Body coordination		Hand coordination				Basketball spot shooting (%)		Dribble and throw		Wall passes (sec.)	
	I	F	I	F	Right		Left		I	F	I	F	I	F
Upper limit	9	10	5.57	5.69	4	5	4	5	60	70	8	9	17	16
Lower limit	6	7	3.80	4.02	1	1	0	0	20	20	5	6	24	23
Amplitude	3.00	3.00	1.77	1.67	3.00	4.00	4.00	5.00	40	50	3	3	7	7
Mean	7.47	8.47	4.46	4.80	3.27	4.00	2.93	3.6	32.67	42.67	5.80	7.00	21.13	19.33
Standard deviation	0.92	1.13	0.55	0.55	0.8	1.07	1.22	1.35	0.72	0.94	0.7	0.85	2.43	2.23
Coefficient of variation (%)	12.26	13.29	12.29	11.44	24.45	26.73	41.69	37.56	12.42	16.23	10.0	12.07	12.58	11.51
Mean difference	1.00		0.34		0.73		4.13		10.00		1.2		1.8	
Progress (%)	13.39		7.8		22.45		22.73		30.61		20.69		9.31	
Effect size	1.87		1.27		1.6		1.37		3.31		1.7		0.74	
Test Student														
(critical t =2.14)	7.25		4.92		6.20		5.29		12.78		3.18		4.77	
p<0.05														

shooting test: 30.61%.

In the Dynamic balance test the average raise was 13.39%, while in the Body coordination test (3 connected jumps) we observe a 7.8% average raise. In both Hand coordination tests (right and left) the improvements were almost equal: 22.45% for the right hand and 22.73% for the left hand. In the Dribble and throwing test where students were given marks from 1 to 10, we can observe a 20.69% average raise at the final test. Also, in Wall passes drill the mean progress was of 1.8 s, representing a 9.31% better results.

The t-test value is higher than critical t's value for all the 6 battery tests' as it can be seen in table 3. Consequently, the null hypothesis is rejected and the hypothesis of this study is validated.

The effect size calculated is between 0.74 in wall passes drill test and 3.31 in spot shooting test. These values were compared with Cohen effect size index where $d=0.2$ is considered to be small; 0.5 medium; 0.8 large and 1.3 very large [21]. Effect size calculated in 5 of 6 tests are very large and in one case (wall passes) the effect size is very close to the large level. The largest size effect was obtained in Spot shooting test, ability which is decisive in achieving a satisfactory basketball play and scoring possibility.

Our experience in physical education lessons has confirmed that fatigue may occur in lessons with excessive focus on intense training. Therefore, it is recommended to give quite long breaks between series – especially in the second part of the lesson [22], otherwise the students' ability to develop transferable athletic skills may be impeded.

The deciding factor in formation, development and master of coordination skills is the method of repeating through continuous and progressive diversification of motor actions in compliance with the characteristics and means that are specific to the targeted level. In basketball case, we recommend teaching the overall technical procedures, as well as using several well-known exercises to make the process of developing coordination skills more accessible.

Our study findings are consistent with recent pedagogical experiments on female university students attaining physical education classes. In two cases the intervention consisted in choreography [23] and dance [19] exercises and there were effective in developing the coordination skills. Another study on the same age range and gender [20] demonstrated that the coordination skills are more likely to be improved compared to speed as a skill related fitness component. Furthermore, in basketball as a team sport, a high level of coordination abilities is a prerequisite for improvement of the technique and tactic of the game.

Conclusions

Using the means specially designed to develop coordination skills has led to very good results, which have positively influenced the learning process of playing basketball. Coordination is the function that constrains the potentially free variables into a behavioral unit, while skill is the optimal manifestation of this function. The coordination skills developed can be transferred in everyday life and lead to a substantial improvement of overall life quality.

Following the results in all 6 tests, we observed a significant statistical improvement at the final test, which proves that the study's hypothesis has been validated. Also, the effect size in 5 of 6 tests was very large and in the 6-th test, the result is near the large threshold.

From the teaching experience gathered throughout the study, we have concluded:

- Learning and perfecting technical procedures is conditioned by the level of the coordination skills displayed;
- High level of coordination skills allow the performance of motor actions in various situations;
- High level of coordination skills allow superior valorization of other motor skills.

The instructive-educative process features are a low volume of effort, with exercises placed in the

Table 3. Research hypothesis

Item No.	Test	Initial	Final	Observation	Effect	Study hypothesis
1	Dynamic balance	7.47	8.47	13.39% raise	V. Large	Accepted
2	Body coordination	4.46	4.80	7.8% raise	V. Large	Accepted
3	Right hand coordination	3.27	4.00	22.45% raise	V. Large	Accepted
4	Left hand coordination	6.66	6.92	22.73% raise	V. Large	Accepted
5	Basketball spot shooting	32.67	42.67	30.61% raise	V. Large	Accepted
6	Throwing the ball while dribbling	5.80	7.00	20.69% raise	V. Large	Accepted
7	Wall passes	21.13	19.33	9.31% raise	Large	Accepted

* $p<0.05$

beginning of the lesson to assure a good mobility in the nervous system.

Limitations

We understand that the modest number of cases in this study may be an issue, but despite

this limitation the result encourages us to believe there are chances to improve coordination skills in physical education of university students.

Conflicts of interest

The authors declare no conflicts of interest.

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Information about the authors:

Cristina I. Nae; (Corresponding Author); <https://orcid.org/0000-0003-1429-4380>; ionela.nae@ase.ro; Department of Physical Education and Sports, Bucharest University of Economic Studies; Bucharest, Romania.

Cristiana L. Pop; <https://orcid.org/0000-0002-6445-8702>; cristina.pop@defs.ase.ro; Department of Physical Education and Sports, Bucharest University of Economic Studies; Bucharest, Romania.

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