

Discriminant analysis: features of training 10-year-old boys in the technique of kicks in kyokushin karate

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- A Study Design
- B Data Collection
- C Statistical Analysis
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Svitlana Marchenko ^{1ABD}, Olha Ivashchenko ^{1ABD}, Wladyslaw Jagiello ^{2ADE},
Sergii Iermakov ^{2,3ADE}, Oleg Khudolii ^{1ABCD}, Tetiana Yermakova^{3BD}

¹Department of Theory and Methodology of Physical Education, H. S. Skovoroda Kharkiv National Pedagogical University, Kharkiv, Ukraine

²Gdansk University of Physical Education and Sport, Gdansk, Poland

³Department of Pedagogy, Kharkiv State Academy of Design and Arts, Kharkiv, Ukraine

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Abstract

Background and Study Aim:

Mass sports and sports events have a decisive influence on the formation of a healthy lifestyle of schoolchildren. Kyokushin karate can be used both as a sport, self-defence and as a health system for all ages. The purpose of the study was the knowledge about the peculiarities of teaching 10-year-old boys the technique of kicks in kyokushin karate based on an innovative methodological approach.

Material and Methods:

Boys aged 10 years (n = 32) took part in the study. The boys performed a series of tasks in accordance with two training programs: techniques of front kicking (mae-geri); roundhouse kicking technique (mawashi-geri). The method of algorithmic instructions was used in the learning process. A discriminant analysis of learning outcomes was conducted.

Results:

Statistically significant boys mastered motor tasks of 1-5 series of training tasks of mawashi-geri (p<0.05). Eigenvalues indicate that the canonical function is highly informative (r = 0.938); analysis of Wilks' Lambda indicates the statistical significance of the canonical function. The values of the centroid coordinates for the two groups indicate significant differences in the learning of mae-geri and mawashi-geri. Eigenvalues analysis shows that the first canonical function explains the variation of results by 84.9%, the second function by 10.7%, and the third function by 3.8%. Canonical correlation values indicate that the first three functions are highly informative (r1 = 0.960; r2 = 0.772; r3 = 0.585). The analysis of canonical functions indicate the statistical significance of the first and second canonical functions ($\lambda_1 = 0.019$; p1 = 0.001; $\lambda_2 = 0.244$; p2 = 0.001). The first, second and third functions have a high discriminant ability and value in the interpretation of the general population.

Conclusions:

Discriminant analysis allowed to determine how reliably the effectiveness of learning the technique of mae-geri and mawashi-geri differs among juvenile karate athletes. Structural coefficients of the discriminant function indicate that the effectiveness of the training program is determined by the selection of a series of learning tasks and the mode of their implementation. The boys have higher mastery of the mawashi-geri technique. The most significant difference in the quality of these learning tasks is also observed between the modes of exercise. A universal option for learning a series of tasks of the mae-geri and mawashi-geri training program for boys aged 10 is the second mode of exercise: 3 approaches with a rest interval of 60 seconds.

Key words:

exercise modes • mae-geri • mawashi-geri • self-defence

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Author's address: Oleg Khudolii, Department of Theory and Methodology of Physical Education, H. S. Skovoroda Kharkiv National Pedagogical University, Kharkiv, Ukraine; e-mail: khudoli@hnpu.edu.ua

Motor – *adjective* relating to muscle activity, especially voluntary muscle activity, and the consequent body movements [1].

Self-defence – *noun* fighting techniques used for defending oneself against physical attack, especially unarmed combat techniques such as those used in many of the martial arts [1].

Skill – *noun* an ability to do perform an action well, acquired by training [1].

Performance – *noun* the level at which a player or athlete is carrying out their activity, either in relation to others or in relation to personal goals or standards [1].

Technique – *noun* a way of performing an action [1].

INTRODUCTION

Physical culture and sports events have a decisive influence on the formation of a healthy lifestyle of schoolchildren [2-4]. Kyokushin karate can be used both as a sport and as a health system for all age groups [5-7]. The application of the basics of karate in extracurricular activities of secondary schools contributes to the formation of special skills and abilities of self-defence in children and increase physical activity [5, 8, 9].

Technical training determines the effectiveness of the process of long-term training, creates a foundation for comprehensive physical and functional training of children and adolescents [10-12], it depends on the further success of the athlete in competitions [13-16].

Multidimensional statistics are an objective method of analysis in the study of the effectiveness of the formation of motor skills and the development of motor skills in children and adolescents [7, 17, 18]. The effectiveness of plans for factor experiments and discriminant analysis in the study of the effectiveness of modes of exercise in the process of learning and development of motor skills has been established [5, 19, 20].

The relevance of the study is due to insufficiently substantiated methods of initial training in technical actions. This makes it necessary to explore

the peculiarities of teaching the technique of kicks in kyokushin karate in the framework of programmed training using the method of strictly regulated exercises.

The purpose of the study was the knowledge about the peculiarities of teaching 10-year-old boys the technique of kicks in kyokushin karate based on an innovative methodological approach.

MATERIAL AND METHODS

Participants

The study involved 32 boys aged 10 years. The children and their parents were informed about all the features of the study and gave their consent to participate in the experiment.

Study Organization

Research methods were used to solve the tasks: study and analysis of scientific and methodological literature, pedagogical observation, timing of educational tasks, pedagogical experiment, methods of mathematical statistics, methods of mathematical planning of the experiment. The conditional distribution of the *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick) learning process is given in Table 1. The method of algorithmic instructions was used in the learning process.

Table 1. Distribution of the process of learning the technique of kicks in kyokushin karate.

Stages of learning	Characteristics of learning stages	Main tasks
First	Acquaintance with a separate type of blow	Creating a preliminary general idea of the kick as a holistic motor act. Detailed acquaintance with the general description and the general principles of technique of performance of kick
Second	Mastering the basic structure of movement	Distribution of impact on the elements
Third	Automation skills	Ability to strike freely in standard conditions
Fourth	Acquisition of the ability to freely and accurately perform a direct hit	Acquisition of one of the most important qualities of a fighter – flexibility of skill: the ability to apply the blow in different combat conditions and depending on the individual characteristics of different opponents

The *mae-geri* direct kick training program includes a series of training tasks.

The first series of learning tasks – exercises for the development of motor skills:

- Stand legs apart, hands on the belt: left (right) leg bent and raised forward (foot parallel to the floor). Hold a stable position for up to 25 seconds. The same, but with closed eyes. Hold a stable position for up to 15 seconds.
- Running on the spot with a rise in the thigh. It is necessary to touch the knee of the rope located at the level of the belt. Fast pace for 10 seconds.

The second series of learning tasks – starting and ending positions:

- Stand legs apart (*yoi dachi*): nape, scapula, buttocks, heels placed in one plane; legs spread shoulder-width apart; feet are parallel; knees relaxed and slightly bent; hands on the belt; body weight is evenly distributed on both legs.
- Stand legs apart; left (right) leg forward (*kumite dachi*): legs are shoulder-width apart and half-bent; feet are parallel; one leg in front, the other behind; the distance between the heel of the left (right) foot and the toe of the right (left) – the middle step; shin of the left leg perpendicular to the floor; the foot touches completely on the floor; the right foot touches the floor only with the toe; torso in position 45°; left (right) shoulder forward; head slightly tilted forward; chin pressed to the collarbone; body weight is evenly distributed on both legs; fist of the left hand at the level of the shoulder joint; elbow lowered; the right hand is freely located near the right side (elbow lowered), fist near the chin.

The third series of learning tasks – actions without which it is impossible to perform the exercise:

- Lying position. Gradual implementation of the phases of direct kick: the phase of removal of the thigh; phase of leg straightening with the formation of the impact surface; leg return phase; phase of resting the leg to the starting position.

The fourth series of learning tasks – learning the ability to control movements:

- Exercise to train the ability to properly and correctly push off the leg that hits the support (in the initial stage of impact). Starting position “Stand legs apart (*yoi dachi*)”: lean back, buttocks and heels against the wall; rapid raising of the knee of the right (left) leg in the forward and upward direction; push your foot off the floor; the heel is pressed against the thigh. Perform 10 times.
- Starting position “Stand on one leg” (lean back against the wall): keeping the right (left) straight leg in the front position; keep your foot at waist height; fix the foot in the final phase of the impact with the lower part of the foot – just under the toes (pad) forward (*chusoku*), 10 s.
- Stand with your back to the wall (facing your partner): right (left) leg bent at the knee; the foot rests on the partner’s abdomen with the lower part of the foot (*chusoku*). Pushing your partner away from you: straighten your leg, include the thigh in the final phase. The partner resists as much as possible. Perform 10 times.

The fifth series of learning tasks – separate parts of the target exercise and sub-exercises:

- Starting position “Stand on the left (right) leg, right (left) leg bent forward” (lean back against the wall): perform a whip extension of the leg at the knee joint (keep the height and position of the foot). Perform 10 times.
- Stand on the left (right) knee: the thigh of the left (right) leg perpendicular to the floor; right (left) leg bent and placed forward on the whole foot – shin parallel to the thigh of the left (right) leg. The torso is located vertically and is held vertically during the exercise. On one account to perform two phases of movement: the movement of the knee in the forward and upward direction; quick extension of the leg at the knee joint. Perform 10 times.

The sixth series of learning tasks – the implementation of the exercise as a whole:

- Practice the technique of kicking in the air: alternating legs from the starting position “Stand legs apart (*yoi dachi*)” (in place). The same from the starting position “Stand leg apart left (right) forward (*kumite dachi*)”. The same from the *kumite dachi* with a step forward (in a straight line). Practice the technique

of kicking on the target for accuracy: from the starting position “Stand leg apart left (right) forward (*kumite dachi*)” (in place). Perform the exercises 10 times. Breathing in all exercises should be correlated with the pace of movement and moments of tension.

The *mawashi-geri chudan* (roundhouse kick middle level) training program consists of the following consecutive series of training tasks.

The first series – exercises to develop motor skills.

- Starting position – stand on one leg; stand facing the gymnastic wall; grip at waist level; the other leg is bent at the knee to the side at waist level; the heel is pressed against the thigh; shin and thigh parallel to the floor. The foot of the supporting leg is parallel to the wall (inside side of the foot to the wall); the heel is turned towards the impact leg. Hold a stable position for up to 10 sec. on each side. Do the same with the other foot.
- Starting position – standing on one leg; the other leg is bent at the knee to the side (as in the previous exercise). After 5 sec. after holding the static position, the command is given – to make a 180° turn towards the supporting leg. After the next 5 sec. you need to return through the same direction. Perform 5 cycles with each leg.
- Starting position – as in exercise II: straighten the leg; direct the impact surface of the *haisoku* (instep of the foot) to the gymnastic wall; fingers extended as far as possible. Keep a straight leg to the side parallel to the floor to 10 with each leg.

The second series – the starting and ending positions.

- Standing position *zenkutsu dachi* (left side). Legs apart shoulder-width apart (left foot forward); standing length – two shoulder widths. The feet touch completely on the floor. The foot of the left leg is directed forward; right at an angle of 45° (fingers outwards). Shin of the left leg perpendicular to the floor; knee over heel; right leg straight. Torso at 45°; left shoulder forward; about 70% of body weight ahead. Hands on the belt. Exit to the *zenkutsu dachi* (forward leaning stance) is performed from the *yoi dachi* position.

- Standing position *yoi dachi*. Legs apart; feet parallel; knees relaxed and slightly bent; the nape of the neck, scapula, buttocks and heels are placed in one plane; hands on the belt; body weight is evenly distributed on both legs.

The third series – actions without which it is impossible to perform the exercise.

- Starting position: lie on the left side (resting on the forearm of the left hand). Gradually perform the phases of the circular kick: the phase of removal of the thigh; leg straightening phase (with the formation of the impact surface); leg return phase; phase of resting the leg to the starting position. The striking attacking surface is *haisoku* (instep of the foot). The upper part (rise) of the foot or *sune uke* (shin). Do the same with the other foot.

The fourth series – learning the ability to control movements:

- Starting position – standing on one leg; hold on to the support; the other leg is bent at the knee; thigh – up and forward (at waist level). The head, shoulder joints, torso, hips and striking leg are in the same plane. The heel of the supporting leg is directed towards the target. Withdraw the hip bent leg back and simulate a blow to the knee (active movement of the pelvis over the “pillow”) on the palm of the partner.
- The starting position is the same as in the previous exercise. Perform whiplash extension and flexion of the leg at the knee joint [maintain the height and position of the foot *haisoku* (instep of the foot)]. Perform 10 times with each leg.

The fifth series – separate parts of the target exercise and submarine exercises:

- Starting position – to stand sideways to the partner: hold the partner with the same hands; torso in position 180°; shoulder forward; the hind support leg is turned with the heel towards the partner. Raise the thigh of the front leg up and forward (the heel is pressed against the thigh; the shin and thigh are parallel to the floor). Perform whiplash leg extension; return the leg to its original position.
- Starting position – left stance *zenkutsu dachi* (forward leaning stance). Transfer body weight

to the supporting left. At the same time lift up and forward the thigh of the right leg; push your foot off the floor; torso and left foot rotate 135°. Strike with an active movement of the pelvis forward and quick extension of the right leg. Return the foot to its original position on the impact trajectory. The arms are bent; elbows touch the torso; fists at chin level.

The sixth series – the implementation of the exercise as a whole:

- Practice the technique of kicking the back foot into the air (from the *zenkutsu dachi* stance (forward leaning stance)) on an imaginary goal with advancement. Perform 10 times.
- Practice the technique of kicking on the target on the accuracy of the *zenkutsu dachi* stance (forward leaning stance) from the ground. Perform 10 times.

Look in the direction of the kick. Breathing in all exercises should be correlated with the pace of movement and moments of tension.

The transition to the next exercise should be carried out provided that the previous exercise is performed correctly in strict compliance with all technical requirements. At the same time, minor mistakes were made.

The level of mastery of the technique of direct kicking *mae-geri* (Y) was assessed by a group of independent experts of three people on a 10-point scale: 10 – motor action is performed correctly, all technical requirements are met exactly; 9 – motor action is performed correctly, but one minor error is made; 8 – motor action is performed in accordance with the requirements freely, but no more than two minor errors; 7 – motor action is performed in accordance with the requirements, but no more than three minor errors; 6 – motor action is performed basically correctly, but with one significant error; 5 – motor action is performed generally correctly, but with one significant and not more than one minor error; 4 – motor action is performed with one significant and not more than two minor errors; 3 – when performing a motor action, one gross error was made and the number of other errors is more than two; 2 – when performing a motor action, two gross errors were made; 1 – motor action performed with more than two gross errors.

To solve this goal, the influence of different exercise options was studied, namely: the number of approaches (X_1) and rest intervals (X_2) on the mastery of the technique of front kicking *mae-geri*. The boys were divided into four groups according to the experimental plan. The differences between the groups in the method of conducting classes were dictated by the conditions of the factorial experiment (Table 2). The lower and upper levels of factors were selected based on data from Khudolii and Ivashchenko [21], Khudolii et al. [22], as well as limited to the scope of training.

Table 2. Factor experiment plan (FEP) type 2².

Exercise options	Learning modes	
	number of approaches, times (X_1)	rest interval, sec (X_2)
1	1 (-)	60 (-)
2	3 (+)	60 (-)
3	1 (-)	120 (+)
4	3 (+)	120 (+)

Statistical analysis

The methods of analysis of the results of mathematical planning of the experiment FEP 2^k were used in the work [23].

The empirical data were developed in IBM SPSS 20. In the process of discriminant analysis, a prognostic model for group membership was created. This model builds a discriminant function (or, when there are more than two groups, a set of discriminant functions) in the form of a linear combination of predictor variables, which provides the best division of groups. These functions are based on a set of observations for which their membership in groups is known. These functions can be further applied to new observations with known values of predictor variables and unknown group affiliation.

For each canonical discriminant function were calculated: eigenvalue, percentage variance, canonical correlation, Wilks' Lambda, χ -square (Chi-square).

RESULTS

Discriminant analysis of the learning outcomes of *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick) showed that statistically significant

boys mastered motor tasks of 1-5 series of training tasks of *mawashi-geri* (roundhouse kick) ($p < 0.05$, Tables 3 and 4).

Table 3. Group statistics.

Series	Mean	SD	Valid N (leastwise)	
			unweighted	Weighted
Exercise 1 <i>mae-geri</i> (front kick)				
1	7.25	1.56	32	32.00
2	5.33	0.88	32	32.00
3	7.56	1.21	32	32.00
4	5.50	1.17	32	32.00
5	6.44	1.23	32	32.00
6	7.52	1.44	32	32.00
Exercise 2 <i>mawashi-geri</i> (roundhouse kick)				
1	9.20	0.84	32	32.00
2	9.02	0.760	32	32.00
3	8.42	1.18	32	32.00
4	8.10	1.16	32	32.00
5	8.45	0.95	32	32.00
6	8.15	1.27	32	32.00

Table 4. Tests of equality of group means.

Series	Wilks' Lambda	F	df1	df2	Sig.
1	0.618	38.311	1	62	0.000
2	0.161	324.229	1	62	0.000
3	0.884	8.127	1	62	0.006
4	0.438	79.549	1	62	0.000
5	0.536	53.701	1	62	0.000
6	0.948	3.390	1	62	0.070

Table 5. Eigenvalues.

Function	Eigenvalue	% of Variance	Cumulative %	Canonical correlation
1	7.345 ^a	100.0	100.0	0.938

Table 6. Wilks' Lambda.

Test of function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	0.120	125.177	6	0.000

Eigenvalues indicate that the canonical function is highly informative ($r = 0.938$); analysis of Wilks' Lambda indicates the statistical significance of the canonical function (Tables 5 and 6). The values of the centroid coordinates for the two groups indicate significant differences in the learning of *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick) (Table 7).

Table 7. Functions at Group Centroids.

Variable	Exercise	
	1 <i>mae-geri</i> (front kick)	2 <i>mawashi-geri</i> (roundhouse kick)
	1.00	2.00
Function 1	-2.667	2.667

Eigenvalues discriminant analysis shows that the first canonical function explains the variation of results by 84.9%, the second function by 10.7%, and the third function by 3.8%. Canonical correlation values indicate that the first three functions are highly informative ($r_1 = 0.960$; $r_2 = 0.772$; $r_3 = 0.585$) (Table 8).

Empirical data for the analysis of canonical functions indicate the statistical significance of the first and second canonical functions ($\lambda_1 = 0.019$; $p_1 = 0.001$; $\lambda_2 = 0.244$; $p_2 = 0.001$). The first, second and third functions have a high discriminant ability and value in the interpretation of the general population (Table 9).

The structural coefficients of the first canonical discriminant function indicate that it has the highest correlation with learning tasks of the 2nd series ($r_{12}^* = 0.825$), the second function - with learning tasks of the 6th series ($r_{26}^* = 0.821$), the third function - with learning tasks of the 1st series ($r_{31}^* = 0.687$), the fourth function - with learning tasks 4 series ($r_{44}^* = 0.660$). The most

Table 8. Eigenvalues.

Function	Eigenvalue	% of Variance	Cumulative %	Canonical correlation
1	11.731 ^a	84.9	84.9	0.960
2	1.477 ^a	10.7	95.6	0.772
3	0.521 ^a	3.8	99.4	0.585
4	0.055 ^a	0.4	99.8	0.228
5	0.032 ^a	0.2	100.0	0.176
6	0.001 ^a	0.0	100.0	0.029

Table 9. Wilks' Lambda.

Test of function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 6	0.019	221.542	42	0.000
2 through 6	0.244	79.076	30	0.000
3 through 6	0.603	28.288	20	0.103
4 through 6	0.918	4.788	12	0.965
5 through 6	0.968	1.801	6	0.937
6	0.999	.047	2	0.977

significant difference in the quality of these learning tasks is observed both between the modes of exercise and the quality of *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick) (Table 10).

The coordinates of the centroids for the eight groups (Table 11) they allow us to interpret the canonical function in relation to the role in the classification. The graphic visualization shows the density of objects in each class and the clear boundary between classes (Figure 1)). The most universal in the process of learning both series of tasks and techniques of *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick) is the second mode of exercise.

DISCUSSION

The general attention is that a full factorial experiment and discriminant analysis will determine the peculiarities of training boys aged 10 of technique of *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick) in kyokushin karate. The results of the study show that in the proposed matrix of the factor experiment plan the chosen step of factor variation is sufficient to study the influence of different modes of exercise on the effectiveness of training (Table 2).

An assumption is made about the possibility of using a discriminant function to assess the effectiveness of different modes of exercise in the process of learning a series of tasks of the training

Table 10. Structure matrix.

Series	Function					
	1	2	3	4	5	6
2	0.825*	-0.174	-0.013	0.029	0.448	-0.295
6	0.170	0.821*	-0.113	0.092	0.004	-0.525
1	0.285	0.220	0.687*	0.268	0.535	-0.203
4	0.400	0.186	0.323	0.660*	-0.514	0.048
3	0.165	0.423	-0.085	0.416	0.571*	0.536
5	0.383	0.410	0.264	-0.487	-0.143	0.598*

Table 11. Functions at Group Centroids.

Variant	Function					
	1	2	3	4	5	6
1.000	-2.527	-0.300	-1.662	0.082	0.044	-0.004
2.000	-2.682	2.030	0.214	-0.034	-0.250	0.010
3.000	-4.200	-1.033	0.423	-0.397	0.060	0.010
4.000	-2.912	0.220	0.729	0.342	0.172	-0.032
5.000	2.366	-0.070	0.216	0.073	0.211	0.048
6.000	4.395	0.373	-0.046	-0.264	0.068	-0.045
7.000	1.769	-2.045	0.254	0.157	-0.274	-0.003
8.000	3.791	.825	-0.128	0.040	-0.031	0.015

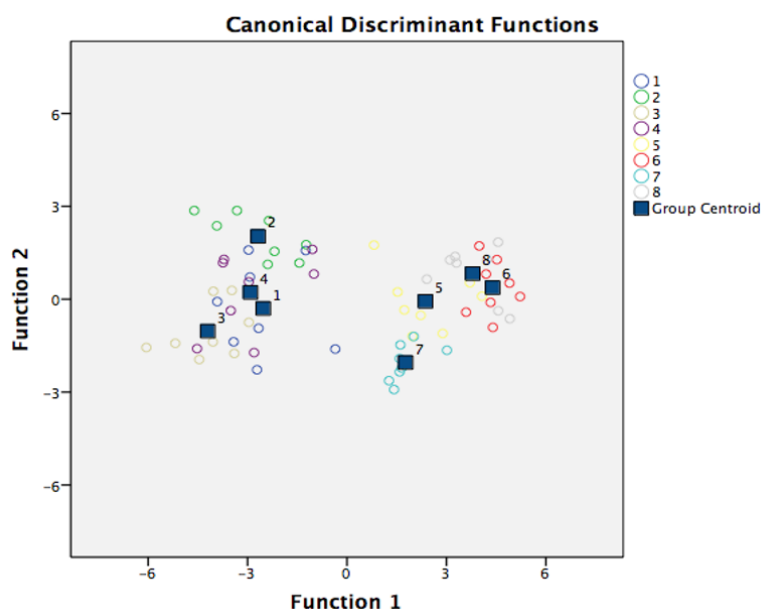


Figure 1. Graphic representation of classification results (modes of physical exercises 1-4 – *mae-geri* (front kick); 5-8 – *mawashi-geri* (roundhouse kick)).

program *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick). Verification of canonical functions indicates their statistical significance, and the coordinates of the centroids allow you to choose the best option to obtain a positive effect of learning a series of exercises, as well as to identify features of learning the technique of percussion. The obtained data confirm the effectiveness of discriminant analysis to assess the effectiveness of the process of formation of motor skills [24, 18, 20].

The obtained results expand and supplement the data of Ivashchenko et al. [24], Iermakov et al. [25] on the effectiveness of the use of factor experiment plans and discriminant analysis in the study of the peculiarities of the formation

of motor skills in children and adolescents. The high informativeness of the canonical functions indicates that in the proposed matrix of the factor experiment plan the chosen step of factor variation is sufficient to study the influence of different modes of exercise on learning efficiency. This is confirmed by the data of, Wang et al. [26], García-Moya et al. [27] on the possibility of using factorial experiment plans in studies involving children and adolescents.

Discriminant analysis allowed to determine how reliably the effectiveness of learning the technique of *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick) differs. 10-year-old boys have higher grades of *mawashi-geri* (roundhouse kick).

The most significant difference in the quality of learning tasks is also observed between the modes of exercise. However, 10-year-old boys have the highest scores in the *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick) learning series show in the second mode of exercise: 3 approaches with a rest interval of 60 sec. The obtained data supplement the information on the formation of motor skills in children [7, 5, 28].

Based on the analysis of structural coefficients of the discriminant function, it was found that the effectiveness of training programs for *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick) among 10-year-old boys is determined by the selection of a series of learning tasks and the mode of their implementation. The obtained data supplement the information on the effectiveness of the method of algorithmic instructions in the formation of motor skills in children and adolescents [7, 29, 20].

In addition, the method of algorithmic instructions provides an opportunity to increase the amount of educational material, which is important for improving the motor activity of children [30, 31].

Thus, as a result of the study, the programs of training the technique of *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick) of 10-year-old boys were substantiated. Features of training of the specified blows, and also the most rational modes of performance of a series of tasks in the course of formation of motor skills are defined. Based on this information, the coach has the opportunity to make or adjust the work plan of the sports section or the individual plan of an student.

Regardless of the argumentation presented, which concerns mainly sport (in detail the training effects of juvenile karate athletes), the recommendations inspired by the perspective of fulfilling the social mission of science are important [32-34]. The cognitive and application value of works informing about

the methods and training means used in a general sense is limited – an example of judo [35]. However, both the method of algorithmic instructions and the statistical analysis used in this work can be widely used not only in sports training, but also in therapy, rehabilitation, adapted physical activity, etc. These two factors resonate with the concept of innovative agonology [34, 36-38], where non-apparatus and quasi-apparatus tests, fun forms of martial arts, motor simulations etc. [39-50] are recommended for the complementary enhancement of health and survival possibility. The use of simple, attractive methods and training means [51, 52] cannot be the basis for the opinion that the sphere of practice is weakly related to scientific recommendations. On the contrary, only the quality of the statistical analysis of empirical data (as evidenced by this work) provides a scientific justification either about the expected value of the methods and means used, or it rejects false assumptions.

CONCLUSIONS

Discriminant analysis allowed to determine how reliably the effectiveness of learning the technique of *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick) differs among 10-year-old boys. Structural coefficients of the discriminant function indicate that the effectiveness of the training program is determined by the selection of a series of learning tasks and the mode of their implementation.

The boys have higher mastery of the *mawashi-geri* (roundhouse kick) technique. The most significant difference in the quality of these learning tasks is also observed between the modes of exercise.

A universal option for learning a series of tasks of the *mae-geri* (front kick) and *mawashi-geri* (roundhouse kick) training program for boys aged 10 is the second mode of exercise: 3 approaches with a rest interval of 60 seconds.

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