

# Simulation of the regularities of physical exercises learning process of boys aged 8 years old

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Authors' Contribution:

A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

## Abstract

**Purpose:** to determine the peculiarities of the formation of motor skills in boys aged 8 years.

**Material:** In study participated boys of eight years old (n=48). The study used factor experiment plans. The purpose of this experiment was to optimize the modes of education and to determine the peculiarities of the formation of motor skills in boys.

**Results:** Discriminant analysis allowed: to determine the modes of exercise in the formation of motor skills; to answer the question as to how significantly different modes of work on the effectiveness of the formation of motor skills. Established: which of the variables most significantly affect the differentiation of classes; to which class the object belongs based on the values discriminant variables. The influence of the number of approaches, the number of repetitions in the approach and the interval of rest on the level of training for movements is revealed.

**Conclusions:** To choose the most rational mode of exercising in the process of forming motor skills can be used the first discriminating function with an emphasis on the most informative variables.

**Keywords:** discriminant function, classification, simulation, learning process, boys.

## Introduction

One of the problems of school physical education is the optimization of the educational process of schoolchildren. Available studies reveal:

- content of the subject physical education and levels of its study at school [1];
- the impact of training load on the effectiveness of education and the health of schoolchildren [2];
- the role of motor activity in the development of school-age children [3];
- methodology for determining the state of development of motor function in children and adolescents [4, 5].

The optimization of the process of learning physical exercises of schoolchildren is revealed in the following works: the influence of modes of exercising on the formation of motor skills [6, 7]; the effectiveness of the use of the methods of programmed education at the lessons of physical culture in school [8]; the effectiveness of using network planning for passing the training material [9, 10]; building learning process based on information models [11, 12]; conditions for the formation of the motor function [13, 14].

The task of physical education of school-age children is the teaching of motor activity and the development of motor abilities [12, 15]. The process of study is considered from the positions: organizations [6, 16], motivation for motor activity (the higher the level of training exercises

the greater the volume of motor activity) [17, 18]; relationships between learning outcomes and motor activity are studied (learning success induces an increase in motor activity) [2, 19]; cognitive and motor learning [20, 21]; teacher's readiness to study; the formation of moral values in the process of motor skills' formation [22]; the impact of motor readiness on the effectiveness of learning [7]; the effect of physical activity on learning effectiveness [23].

In previously published works it was found that the level of motor readiness of schoolchildren affects the ratio of learning processes and the development of motor abilities [24, 25]. The development of motor abilities is effective if they become part of the acquired motor skills. It has been established that the learning efficiency increases if the algorithmic instruction method is used [9, 10] and takes into account the modes of alternating exercise and rest [9]; O.V. Ivashchenko [6]. One of the methods for studying the peculiarities of motor skills in children and adolescents is simulation.

Recent publications have found that simulation is an effective method for obtaining new information about the possibility of conducting current and final control based on testing motor development of children and adolescents [26, 27]. One of the methods of statistical simulation is a discriminant analysis. The effectiveness of its use in the classification of the state of functional and motor fitness of children and adolescents indicate the data of scientific literature [26, 28].

Thus, the study of the peculiarities of the formation of motor skills in junior school pupils is relevant.

The purpose of the study is to determine the peculiarities of the formation of motor skills in boys aged 8 years.

**Material and methods**

*Participants.* The study involved boys aged 8 years old (n=48).

*Organization of research.* In the process of staging the research were used conceptual approaches to planning an experiment in the study of the effectiveness of the learning process and the development of training models [6, 26].

The study used the plans of a factor experiment PFE 2<sup>3</sup> (Table 1). The purpose of PFE was to optimize the training regimens and to determine the peculiarities of the formation of motor skills in boys of 8 years.

In the pedagogical experiment was studied the influence of the number of approaches (x<sub>1</sub>), the number of repetitions in the approach (x<sub>2</sub>) and the intervals of rest (x<sub>3</sub>) on the level of training of gymnastic exercises of 8 years old boys.

In the process of teaching gymnastic exercises in each class, the level of training was evaluated by an alternative method (“fulfilled”, “failed”), the probability of exercise was calculated (p = n/m, where n – is a number of successful attempts, m – is a total number of attempts).

The method of algorithmic instructions was used in teaching children of elementary school age [6, 9, 10]. The training of the forward roll was conducted with boys of 8 years old.

*Statistical analysis.* Materials of the study were developed in the program of statistical analysis – IBM SPSS 20. In the process of discriminant analysis, a prognostic model for membership in the group was created. This model builds a discriminant function (or, when groups are more than two, a set of discriminant functions) in the form of a linear combination of predictor variables that provides the best division of groups. These functions are built on a set of observations for which is

known their belonging to groups. These functions can be applied to the new observations with known values of predictor variables and unknown group belonging.

For each canonical discriminant function, the actual value, the percentage of dispersion, canonical correlation, Wilks’ Lambda,  $\chi$ -square (Chi-square) are calculated.

A discriminatory analysis was conducted to determine the effect of the proposed modes of exercise on 8 years old boys. It was analyzed the influence of the number of approaches, the number of repetitions in the approach and the interval of rest on the level of learning according to the following movements:

1. From position sitting on floor roll back in tuck and turn in initial position;
2. From squat position with hands on floor roll back in tuck and turn in initial position;
3. From standing position with hands on floor, legs are expanded, make forward roll in sitting position with expanded legs;
4. From standing position with hands on floor make forward roll in sitting position in tuck;
5. From standing position with hands on floor make forward roll in sitting position with hands on floor.

**Results**

The first canonical function explains the variation of results by 83.5%, which indicates its high informativity (r=0,862) (Table 2). Materials of the analysis of canonical functions indicate the statistical significance of the first canonical function ( $\lambda=0,216$ ; p=0,001). The first function has a high discriminant ability and meaning in the interpretation of the general population (Table 3).

The structural coefficients of discriminant functions are coefficients of the correlation of variables with a function. They indicate that the functions are significantly related to the level of training of pedicle exercises forward. The level of training of exercises depends on the modes of training, and the level of training caviar forward from the level of training appended exercises (Table 4).

Graphic material (Figure 1) shows the density of

**Table 1.** Matrix of the factor experiment of type 23 in the study of influence of different modes of repetition exercises on their level of training

Experimental groups	Factors		
	x <sub>1</sub> number of approaches (times)	x <sub>2</sub> number of repetitions in approaches (times)	x <sub>3</sub> interval of rest (c)
1	6	1	60
2	12	1	60
3	6	3	60
4	12	3	60
5	6	1	180
6	12	1	180
7	6	3	180
8	12	3	180

**Table 2.** Canonical discriminant function. Own values. Boys aged 8 years old

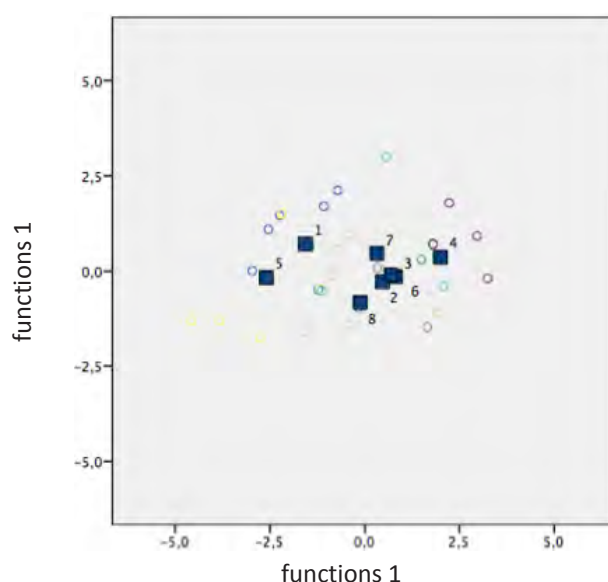
Function	Own values	% explained variance	Cumulative %	Canonic correlation
1	2,140	83,5	83,5	,826
2	,241	9,4	92,9	,441
3	,151	5,9	98,8	,362
4	,030	1,2	100,0	,170

**Table 3.** Canonical discriminant function. Wilks' Lambda. Boys aged 8 years old

Control of functions	Wilks' Lambda	Chi-square	Degree of freedom	p
from 1 to 4	,216	74,996	28	,000
from 2 to 4	,680	18,933	18	,396
from 3 to 4	,844	8,334	10	,596
4	,971	1,435	4	,838

**Table 4.** Structural coefficients of canonical discriminant function. Boys aged 8 years old

Content	Function			
	1	2	3	4
From standing position with hands on floor make forward roll in sitting position in tuck	,505	-,740*	-,187	,403
From position sitting on floor roll back in tuck and turn in initial position	,393	,054	,913*	-,097
From squat position with hands on floor roll back in tuck and turn in initial position	,326	,473	-,138	,807*
From standing position with hands on floor, legs are expanded, make forward roll in sitting position with expanded legs	,492	,453	-,515	-,536*



**Fig. 1.** Canonical discriminatory functions. Graphic representation of the results of the classification of the level of exercise execution of boys aged 8 years: ■ – centroids for data groups after 1-8 variants of exercise modes

objects in each class and the distinct boundary between classes. This material points to the ability to choose the mode of exercise for successful training of the simmer forwards.

To select a variant of the mode of execution of the forward roll into the equation of discriminant function we will substitute the level of training of each exercise, which provides a positive effect of learning:

$$Y = -8,553 + 3,507X_1 + 1,296X_2 + 4,455X_3 + 4,007X_4,$$

$$Y = -8,553 + 3,507 \times 0,75 + 1,296 \times 0,75 + 4,455 \times 0,75 + 4,007 \times 0,75 = 1,395,$$

where Y is the result of the function, X<sub>1</sub> - the level of training of exercise 1, X<sub>2</sub> — the level of training of exercise 2, X<sub>3</sub> — the level of training of exercise 3, X<sub>4</sub> — the level of training of exercise 4.

The obtained result is compared with the values of centroids for the first canonical function (Table 5). The comparison indicates that the most favorable conditions for the training of the forward roll in boys of 8 years are created as a result of the use of the fourth mode of work.

### Discussion

Scientific literature describes the use of discriminatory analysis for classifying the state of preparedness of children and adolescents. Gert-Jan de Bruijn and Benjamin Gardner [29] used discriminant function and dispersion analysis to study the effect of different levels of motivation on the increase in motor activity of young people. Dorita Du Toit et al. [30] through discriminant analysis, studied the relationship between physical fitness and academic achievement at children aged 9-12 years. The boys and girls were classified by level of physical preparedness, motor activity and educational achievements. The positive correlation between components of physical preparedness and academic achievements was revealed by more significant correlations: among girls than boys; among older boys and girls. Lulzim I. [31], with the help of canonical discriminant analysis, found out: is there any change in the morphological and motor performance of girls under the influence of sports. The morphological characteristics (longitudinal circular proportions, proportions of body measurements and proportions of adipose tissue), level of development of motor abilities (explosive force, speed of sprint run and speed of stable run) were analyzed. The result of this study shows that girls (who were actively engaged in sports) had statistically significant differences in all morphological and motor variables in comparison with other girls (who were not active in sports). Geoffrey D. Broadhead and Gabie E. Church [32]: discriminant analysis was used to classify

physical education for children with special needs.

In previous studies, we observed a high discriminant and predictive ability of the functions received: in assessing the motor preparedness of children and adolescents [33, 34]; in the classification of strength loads among schoolchildren of junior grades [35, 36]; in the classification of motor readiness, taking into account the level of training [24, 37].

The obtained data allowed to establish the effectiveness of discriminant analysis in the classification of modes of exercise physical exercise in the formation of motor skills in junior schoolchildren. In the process of analysis, the canonical coefficients of discriminant function (non-standardized) are calculated, which act as factors of the given values of the variables of a discriminant function. On the basis of them it is possible to classify the modes of exercising on the level of training of physical exercises boys aged 8 years, which has practical value.

Consequently, discriminatory analysis allowed to answer the question: how reliable is it possible to classify the modes of exercise; as the level of training of a series of educational tasks affects the assimilation of the exercise as a whole.

### Conclusions

Discriminant analysis allowed to determine: the modes of exercise in the process of forming motor skills; to answer the question as to how significantly different modes of work on the effectiveness of the formation of motor skills; which motor tasks most significantly affect the differentiation of classes; to which class the object belongs to based on the values of discriminant variables.

For the choice of the most rational mode of exercises in the process of developing motor skills in 8 years old boys, the first discriminant function can be used with an emphasis on the most informative variables.

The prospect of further exploration is the study of methodological approaches to pedagogical control of the process of teaching physical exercises of schoolchildren of junior school age.

### Conflict of interests

The authors declare that there is no conflict of interests.

**Table 5.** Functions in centroid groups. Boys 8 years old

Variant of work's regime	Function			
	1	2	3	4
1,00	-1,563	,703	,075	-,171
2,00	,462	-,284	-,116	-,117
3,00	,813	-,145	-,558	,218
4,00	2,005	,362	-,209	-,183
5,00	-2,597	-,171	-,330	,055
6,00	,689	-,100	,100	,038
7,00	,316	,460	,560	,257
8,00	-,125	-,824	,479	-,097

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**Cite this article as:** Ivashchenko OV, Iermakov SS, Khudolii OM, Yermakova TS, Cieślicka M, Harkusha SV. Simulation of the regularities of physical exercises learning process of boys aged 8 years old. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2018;22(1):11–16. doi:10.15561/18189172.2018.0102

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Received: 11.12.2017

Accepted: 30.12.2017; Published: 26.02.2018