

Pattern recognition: the effect of exercise performance modes on the effectiveness of teaching the vault to 8-year-old boys

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Abstract

Background and Study Aim The study purpose was to determine the effect of exercise performance modes on the effectiveness of teaching the vault to 8-year-old boys.

Material and Methods The study participants were 32 boys aged 8 who were divided into 4 groups of 8 persons. The children and their parents were informed about all the features of the study and gave their consent to participate in the experiment. The pedagogical experiment investigated the effect of the number of sets (x_1), the number of repetitions in a set (x_2), and a 60-second rest time on the change in the gain in the level of proficiency of 8-year-old boys in straddle vault over the buck. A method of algorithmic instructions was used in the training. The participants proceeded to the next exercise after three successful attempts.

Results Statistical analysis of the significance of the discriminant functions showed that the first function explains 81.2% of the data variation and has a high canonical correlation value ($r = 0.751$). The first function has a high discriminative ability ($\lambda = 0.332$, $p < 0.021$) and can be used to classify the modes of physical exercise performance in the process of formation of motor skills.

Conclusions The use of multivariate statistics makes it possible to determine the structure of the training program, confirm the effectiveness of the selection of motor tasks, and classify the modes of physical exercise performance during the training process. The best mode of physical exercise performance in teaching the vault to 8-year-old boys is 12 sets of 3 repetitions with a rest time of 60 seconds.

Keywords: 8-year-old boys, vault, exercise performance modes, discriminant analysis

Introduction

The problem of the formation of motor skills in school students is addressed in the papers by Litvin and Marchenko [1], Kharkovshchenko [2], Samsudin et al. [3]. The learning process lies at the heart of the physical education of school students [4, 5, 6]. The formation of fundamental motor skills in the process of physical education of school students is considered as the basis for mastering basic gymnastics exercises and sports-oriented exercises [7, 8, 9].

The importance of the selection of motor tasks, the development of programmed learning materials in the process of formation of motor skills in physical education classes is pointed out by Kharkovshchenko [2], Kapkan et al. [10], Shueva et al. [11]. Optimizing the modes of physical exercise performance in the process of development of motor abilities [12] and formation of motor skills [13] is an important factor in increasing the effectiveness of programmed learning.

Multivariate methods of mathematical statistics, including factor and discriminant analysis, are used to investigate the regularities of the process of

formation of motor skills. Factor analysis makes it possible to determine the structure and informative indicators of the motor fitness of school students [14, 15, 16]. Discriminant analysis is suitable both for determining the structure of motor fitness [17, 18, 19] and for classifying the level of fitness [20, 21, 22]. Therefore, the use of multivariate statistics will make it possible to obtain new information about the regularities of the formation of motor skills in school students.

The study purpose was to determine the effect of exercise performance modes on the effectiveness of teaching the vault to 8-year-old boys.

Materials and Methods

Participants

The study participants were 32 boys aged 8 who were divided into 4 groups of 8 persons. The children and their parents were informed about all the features of the study and gave their consent to participate in the experiment.

Research Design

The pedagogical experiment investigated the effect of the number of sets (x_1), the number of repetitions in a set (x_2), and a 60-second rest time

on the change in the gain in the level of proficiency of 8-year-old boys in straddle vault over the buck (Table 1).

A method of algorithmic instructions was used in the training of the elementary school-aged children. The participants proceeded to the next exercise after three successful attempts. The boys aged 8 were skilled in hurdle stepping onto springboard.

In training, the level of proficiency in motor tasks was assessed in each class using an alternative method ('performed', 'failed'), and the probability of the exercise performance was calculated ($p = n/m$, where n is the number of successful attempts and m is the total number of attempts).

The proficiency level was recorded for the following exercises:

1. Take-off from lying support straddle stand, and straighten up quickly.
2. 2-3 step running squat mount and straddle jump dismount.
3. 2-3 step running vault, piked straddle stand on top of side horse, and arched jump dismount.
4. From squat position on horse to straddle vault over horse or buck in front.
5. Running vault over side horse.

Statistical analysis

The study results were analyzed using the SPSS 20 statistical analysis application program. Elementary statistics were calculated. Discriminant analysis was carried out to classify the effect of the proposed modes of performance of training tasks.

The study protocol was approved by the Ethics Committee of the University. Furthermore, the children and their parents or legal guardians were fully informed about all the special aspects of the study and all the parents or legal guardians gave their consent thereto.

Results

The analysis of the study results showed that a significant difference in the level of proficiency after four modes of physical exercises is observed in the performance of exercise 5 'Running vault over side horse' ($p < 0.001$). The greatest effect is observed after the fourth mode of exercise performance. The mode of exercise performance 12 sets of 3 repetitions with a rest time of 60 seconds is the best (Table 2).

Statistical analysis of the significance of the discriminant functions showed that the first function explains 81.2% of the data variation and

Table 1. The matrix of the factorial experiment with a 2x2 factorial design in investigation of the effect of different modes of exercise repetition on the level of proficiency therein.

Experimental groups	Factors		
	x_1 number of sets (times)	x_2 number of repetitions in a set (times)	rest time (s)
1	6	1	60
2	12	1	60
3	6	3	60
4	12	3	60

Table 2. Group Statistics. Boys aged 8.

Training tasks	Training task performance modes								F	p
	1		2		3		4			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Task 1	0.4786	.32524	.5450	.30487	.7100	.27733	.7525	.15276	1.762	.178
Task 2	0.7157	.23050	.8350	.17639	.7513	.23588	.6700	.00000	1.128	.355
Task 3	0.6214	.22981	.6263	.27841	.7112	.21149	.8350	.17639	1.512	.234
Task 4	0.6643	.19060	.6263	.11575	.5450	.17254	.7525	.15276	2.341	.096
Task 5	0.6629	.00488	.5463	.24553	.5875	.15276	.9175	.15276	7.991	.001

1. – Take-off from lying support straddle stand, and straighten up quickly. 2. – 2-3 step running squat mount and straddle jump dismount. 3. – 2-3 step running vault, piked straddle stand on top of side horse, and arched jump dismount. 4. – From squat position on horse to straddle vault over horse or buck in front. 5. – Running vault over side horse.

has a high canonical correlation value ($r = 0.751$). The first function has a high discriminative ability ($\lambda = 0.332$, $p < 0.021$) and can be used to classify the modes of physical exercise performance in the process of formation of motor skills (Tables 3, 4).

The standardized coefficients of the first discriminant function show that task 5 'Running vault over side horse' has the greatest weight in the system of motor tasks, and analysis of the coefficients of the second and third functions indicates a significant contribution to the effectiveness of the target skill of the proposed tasks (Table 5).

The structure coefficients also show that task 5

'Running vault over side horse' is most correlated with the first function, the coefficients of the motor task correlation with the second and third functions indicate the integral structure of the proposed vault training program (Table 6).

The Functions at Group Centroids analysis indicates that the mode of exercise performance providing for 12 sets of 3 repetitions with a rest time of 60 seconds is the best (Table 7).

Discussion

The study assumed that the use of multivariate statistics would make it possible to determine the

Table 3. Eigenvalues. Boys aged 8.

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.292	81.2	81.2	.751
2	.237	14.9	96.1	.438
3	.062	3.9	100.0	.241

Table 4. Wilks' Lambda. Boys aged 8.

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 3	.332	28.100	15	.021
2 through 3	.761	6.951	8	.542
3	.942	1.528	3	.676

Table 5. Standardized Canonical Discriminant Function Coefficients. Boys aged 8.

Training tasks	Function		
	1	2	3
Task 1	.177	.610	-.121
Task 2	-.179	.468	.990
Task 3	.397	.478	.655
Task 4	.032	-.721	.425
Task 5	.930	.086	-.084

Table 6. Structure Matrix. Boys aged 8.

Training tasks	Function		
	1	2	3
Task 1	.822*	-.243	.057
Task 2	.255	.686*	.062
Task 3	.329	.342*	.108
Task 4	-.269	.077	.700*
Task 5	.357	-.559	.585*

Table 7. Functions at Group Centroids. Boys aged 8.

Exercise performance mode	Function		
	1	2	3
1	-.295	-.660	-.259
2	-1.017	-.087	.321
3	-.466	.641	-.193
4	1.741	.023	.098

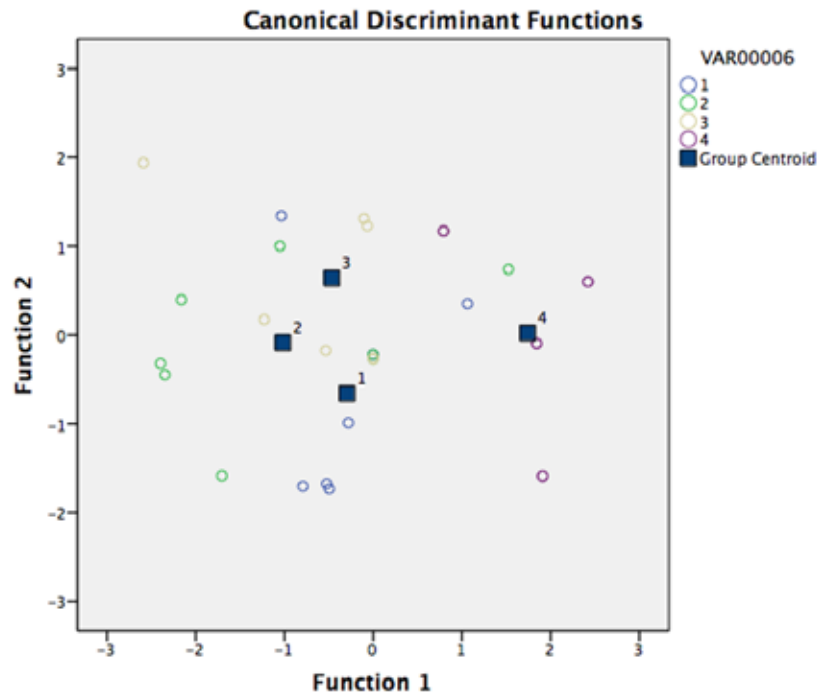


Figure 1. Canonical discriminant functions. A graphical display of the results of the classification of the modes of performance of training tasks in teaching the vault to 8-year-old boys: ■ –centroids for training task performance modes 1, 2, 3, 4.

structure of the vault training program, to confirm the effectiveness of the selection of motor tasks, and to classify the modes of physical exercise performance in the training process.

The obtained data indicate that all training tasks in the structure of the program are related to the effectiveness of the first, second and third discriminant functions. This indicates the effectiveness of their selection. Statistical analysis of the significance of the discriminant functions and analysis of centroids indicate the objectivity and reliability of the classification of physical exercise performance modes in the process of motor skills formation. The given results complement the data that discriminant analysis can be effectively used in determining the structure of motor fitness [17, 18, 19] and in fitness level classification [20, 21, 22]. This conclusion is confirmed by the provided graphic material (Fig. 1).

Discriminant analysis made it possible to establish that the selection of motor tasks, the development of training programs and the optimization of training task performance modes are all an integral process that requires further research. The obtained data complement the conclusions about the topical problems of physical education of children and adolescents [23, 24, 25] and the need to focus attention on increasing the motor activity of children [26].

The study established that the exercise performance mode providing for 12 sets of 3 repetitions with a rest time of 60 seconds is the best in the process of motor skills formation. This emphasizes that the optimization of physical exercise performance modes in the process of motor skills formation [1, 12, 21] is an important factor in increasing the effectiveness of programmed learning.

Conclusions

It was established that the selection of motor tasks, the development of training programs and the optimization of training task performance modes are all an integral process that requires further research.

The use of multivariate statistics makes it possible to determine the structure of the training program, to confirm the effectiveness of the selection of motor tasks, and to classify the modes of physical exercise performance in the training process. The exercise performance mode providing for 12 sets of 3 repetitions with a rest time of 60 seconds is the best in the process of teaching the vault to 8-year-old boys.

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