

SIMULATION OF PROCESS OF 14-15 YEARS OLD GIRLS' TRAINING OF LIGHT ATHLETIC AND GYMNASTIC EXERCISES

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Abstract. *Purpose:* to optimize physical exercises' training regiment in educational process of 14-15 years old girls. *Material:* in experiment girls of 14 years' age (n=24) and 15 years' (n=24) participated. The plan of factorial experiment was used. *Results:* we have shown influence of quantity of exercises' repetitions (X_1) and rest intervals (X_2) on effectiveness of physical exercises' training. We have offered complex approach to studying of objects, which admits simultaneous varying of several factors for assessment of their interactions' influence. Simultaneous varying of factors by special program ensured studying of each of them in different conditions. It permitted to receive more reliable conclusions, suitable for changeable conditions. *Conclusions:* it was established that increase of training process's effectiveness is possible on the base of analysis of regressive models, calculation of optimal modes of physical exercises' fulfillment in process of their mastering at school physical culture lessons.

Key words: simulation, regressive models, physical exercises, modes of training.

Introduction

Simulation in physical education is one of effective methods for searching and optimizing of training process (S.S. Iermakov [1, 2, 3]; O.M. Khudolii, S.S. Iermakov [13]; O.M. Khudolii, O.V. Ivashchenko [7, 11, 12]; O.M. Khudolii [14]). Simulation of complex, holistic processes permits to better understand the studied phenomenon, learn its content, establish visual connections, mark out the most substantial components and so on. Such approach is an effective mean of testing of theoretical ideas' about studied object correctness and completeness [11, 12, 16, 19, 20, 22, 23, 27- 30].

Analysis of scientific-methodic literature points at purposefulness of attention's concentration on formation of children's and adolescents' motor function [16, 19, 20]. Technologizing of training process in secondary school is elucidated in works of O.V. Ivashchenko [4], O.M. Khudolii [10, 15], O.M. Khudolii ra O.V. Ivashchenko [17], O.M. Khudolii and A.A. Titarenko [9]. Conceptual approaches to planning of experiment in research of training process's effectiveness, in development of training models were grounded in works by O.M. Khudolii, O.V. Ivashchenko [7, 12, 16, 18]. Control over training process will be more effective, if orientation of training process is determined at different stages, considering modes of physical exercises' fulfillment in process of their mastering [5, 6, 8, 15].

Thus, simulation of secondary school pupils' training process is rather urgent.

Purpose, tasks of the work, material and methods

The purpose of the research – is to optimize physical exercises' training regiment in educational process of 14-15 years' old girls.

The methods and organization of the research: in our work we used analysis and generalization of scientific-methodic literature, Internet resource, pedagogic testing; methods of mathematical planning of experiment (FFE 2²), pedagogic experiment, method of simulation.

In the process of tasks' formulation we used conceptual approaches to planning of experiment. It concerned studying of training process's effectiveness and working out of training models [7, 11, 12, 16, 18]. It was determined that increase of effectiveness of control over training process is possible if for calculation of training models regressive models, received as a result of full factorial experiment (FFE) of FFE 2^k type are used.

In the research we used plans of factorial experiment of FFE 2² type (see table 1). We studied motor modes of training of side roll, forward and back rolls, forced headstand, throwing of small ball and long jump from run.

Table 1

Matrix of factorial experiment 2-2 plan in studying of influence of quantity of repetitions (X_1) and rest intervals (X_2) in one lesson on process of 14-15 years' old girls' training of physical exercises

№ of experiment	Elements of coded variables	
	X_1	X_2
1	6 –	60 –
2	12+	60 –
3	6–	120 +
4	12 +	120 +

In physical exercises' training, at every lesson we assessed level of mastering by alternative method (“fulfilled”, “not fulfilled”); calculated probability of exercise's fulfillment ($p = n/m$, where n — quantity of successful attempts, m

— general quantity of attempts). Besides, we analyzed level of physical exercises' mastering.

In training of 14—15 years' age girls the method of algorithmic orders was applied. Transition to next exercise was realized after three successful attempts.

In experiment 24 – 14 years' old girls and 24 – 15 years' age participated.

Plan of factorial experiment permitted to study influence of quantity of repetitions (X_1) and rest intervals (X_2) on effectiveness of physical exercises' training of 14-15 years' age girls as well as to use complex approach to studying of objects, which admits simultaneous varying of several factors for assessment of them and their interactions' influence. Simultaneous varying of factors, conducted by special program, ensured studying of every of them in different conditions. It permitted to obtain more reliable results, suitable for changeable conditions.

Results of the research

For achievement the best pedagogic effect in girls' training of physical exercises we determined optimal correlations of quantity of exercises' repetitions (X_1) and rest intervals (X_2). In table 1 we present matrix of full factorial experiment's plan for studying of influence of different physical exercises fulfillment modes on effectiveness of training. Bottom and top factors were chosen on the base of data of O.M. Khudolii and O.V. Ivashchenko [16]: so, we considered frames of lesson and requirements of Governmental program. Distinctions in methodic of trainings' conduct were outlined by conditions of factorial experiment.

As a result we found out regressive dependence of results of quantity of repetitions' (X_1) and rest intervals' (X_2) influence on training process in compliance with age and gender peculiarities of the trained girls (see table 2).

Table 2

Regressive dependence of results in 14-15 years' old girls' training on quantity of repetitions (X_1) and rest intervals (X_2)

№	Description of exercises	Equations of regression for coded variables
14 years' old girls		
1	Side roll	$Y = 0,682 - 0.087X_1 + 0.097 X_1X_2$
2	Forward roll	$Y = 1.54 - 0.18 X_1$
3	Backward roll	$Y = 0.735 - 0.125X_1 - 0.75 X_2$
4	Forced headstand	$Y = 0.4 + 0.14 X_1X_2$
5	Throw of small ball	$Y = 0.835 + 0.65 X_1X_2$
6	Long jump from run	$Y = 0.775 - 0.065 X_1$
15 years' old girls		
1	Side roll	$Y = 0.85 - 0.04 X_1 - 0.07 X_2$
2	Forward roll	$Y = 0.725 - 0.085 X_1$
3	Backward roll	$Y = 0.7 - 0.11 X_1 - 0.07 X_2$
4	Forced headstand	$Y = 0.715 - 0.085 X_1 - 0.055 X_2$
5	Throw of small ball	$Y = 0.815 - 0.045 X_1$
6	Long jump from run	$Y = 0.765 - 0.045 X_2 + 0.075 X_1X_2$

The process of pupils' training of physical exercises is influenced by every factor in different way.

Thus, in respect to 14 years' old girls effectiveness of trainings is influenced by quantity of repetitions in lesson. Increase of these repetitions up to 12 influences negatively. Interaction of quantity of repetitions and rest intervals also

influences on effectiveness of training process. Mastering level increases with increasing of quantity of repetitions up to 12 times and rest interval – up to 120 sec. (forced headstand and throwing of small ball).

In training of “Side roll” by 15 years’ old girls negative influence was rendered by first factor (X_1) and by second factor (X_2). In second exercise “Forward roll” factor (X_1) influences negatively. In third exercise “Backward roll” first factor (X_1) and second factor (X_2) influence negatively. In fourth exercise “Forced headstand” negative influence was rendered by first factor (X_1) and by second factor (X_2). In fifth exercise “Throw of small ball for distance” first factors (X_1) influences negatively. In sixth exercise “Long jump from the spot” second factor (X_2) influences negatively and interaction of both factors (X_1X_2) influence positively.

Thus, in respect to 15 years’ old girls effectiveness of trainings is influenced by quantity of repetitions in lesson and rest interval. Optimal conditions are created with 6 repetitions of exercise and rest interval 60 sec.

Simultaneous varying by special program showed influence of each of these factors in different conditions.

Results of dispersion analysis show influence of the modes on girls’ training (see table 3, figs. 1, 2).

Table 3

Results of dispersion analysis for FFE 2², which shows influence of quantity of repetitions (X_1) and rest intervals (X_2) on training of physical exercises by pupils of 14-15 years’ old age

Description of exercises	Relation of mean squares (%)		
	X_1	X_2	X_1X_2
14 years’ old girls			
Side roll	42	2	54
Forward roll	97	0	2
Backward roll	73	26	0
Forced headstand	19	3	77
Throw of small ball	5	0	94
Long jump from run	69	10	20
15 years’ old girls			
Side roll	23	71	5
Forward roll	33	61	5
Backward roll	69	28	2
Forced headstand	66	27	5
Throw of small ball	11	85	3
Long jump from run	0	26	73

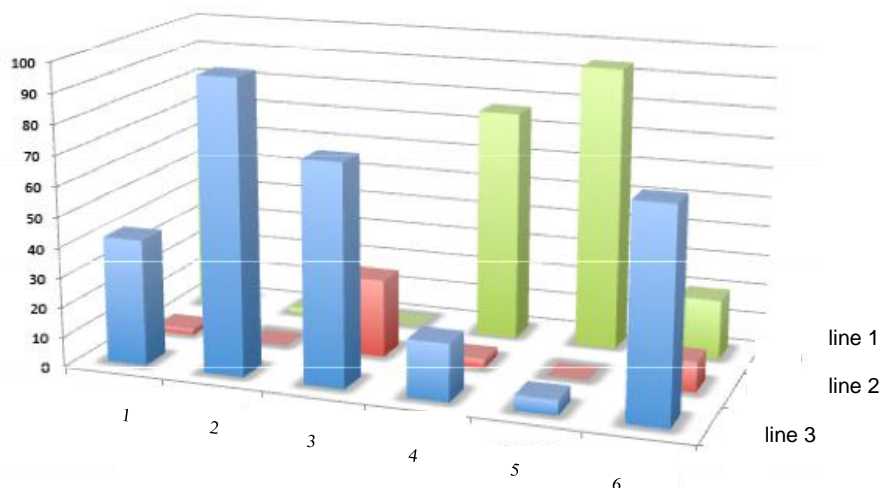


Fig.1. Graphic representation of mean squares' relations (%).14 years old girls: line 1 — X_1 (quantity of repetitions), line 2 — X_2 (rest interval), line 3 — X_1X_2 (interaction of quantity of repetitions and rest intervals)
1-Side roll, 2-Forward roll, 3-Backward roll, 4-Forced headstand, 5-Throw of small ball, 6-Long jump from run

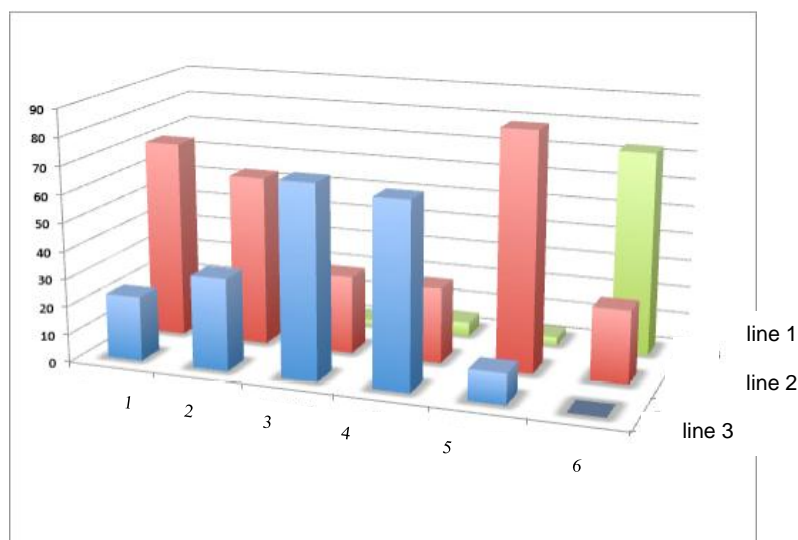


Fig.2. Graphic representation of mean squares' relations (%).15 years old girls: line 1 — X_1 (quantity of repetitions), line 2 — X_2 (rest interval), line 3 — X_1X_2 (interaction of quantity of repetitions and rest intervals)
1-Side roll, 2-Forward roll, 3-Backward roll, 4-Forced headstand, 5-Throw of small ball, 6-Long jump from run

In percentage the highest influence is rendered by first factor and the least – by second. For example, in respect to 14 years' girls in "Side roll" – 42% of quantity of repetitions and 54% of interaction of quantity of repetitions and rest intervals. In second exercise "Forward roll" influence was the following: 73% - quantity of repetitions and 26% - rest intervals. In fourth exercise "Forced headstand" influence was the following: 77% - interaction of rest intervals and quantity of repetitions. In fifth exercise "Throw of small ball for distance" influence was the following: 94% - interaction of rest intervals and quantity of repetitions. In sixth exercise "Long jump from the spot" influence was: 69% - quantity of repetitions and 20% - interaction of rest intervals and quantity of repetitions.

In respect to 15 years' girls in "Side roll" – 23% of quantity of repetitions and 71% of quantity of repetitions and rest intervals' interaction. In second exercise "Forward roll" influence was the following: 33% - quantity of repetitions and 61% - rest intervals. In third exercise "Back roll" 69% - quantity of repetitions and 28% - rest intervals. In fourth exercise "Forced headstand" influence was the following: 66% - quantity of repetitions and 27% - rest intervals. In fifth exercise "Throw of small ball for distance" influence was the following: 85% - rest intervals and 11% - quantity of repetitions. In sixth exercise "Long jump from the spot" influence was: 73% - interaction of rest intervals and quantity of repetitions and 26% - rest intervals.

Results of dispersion analysis witness that for 14-15 years' old girls the most optimal modes are 6-12 repetitions of exercise and rest intervals 60 – 120 sec. In training of 14 years' old girls attention should be paid to quantity of repetitions in one lesson; for 15 years' old girls attention should be paid to increasing of rest interval (see table 4).

Table 4

Comparative characteristic of studied factors' influence on effectiveness of 14-15 years' old girls' training

Description of exercises	age	
	14 years	15 years
Side roll	X_1X_2	X_2
Forward roll	X_1	X_2
Backward roll	X_1	X_1
Forced headstand	X_1X_2	X_1
Throw of small ball	X_1X_2	X_2
Long jump from run	X_1	X_1X_2

Discussion

Results of the research witness that in the offered matrix of factorial experiment's plan the method of factors' varying is sufficient for studying of influence of different modes of physical exercises' training by children and adolescents (see table 1).

These results expand and supplement the data of O.M. Khudolii ta O.V. Ivashchenko [12, 16] about effectiveness of factorial experiment plans' application in studying of training process's effectiveness and development of children's and adolescents' motor skills. In opinion of García-Moya, I., Moreno, C., & Jiménez-Iglesias [19], A. Wang, A., Karns, J. T., & Meredith, W., García-Moya [36] usage of factorial experiments' plans in researches, involving children and adolescents, facilitate increase of quality of their progress assessment. Validity of full factorial experiment of 2^k type usage is proved by data of et.al. [20, 21].

The received data supplement information presented in works of Ivashchenko O.V., Khudolii O.M., Yermakova T.S., Pilewska Wiesława, Muszkieta Radosław, Stankiewicz Błazej [22], Ivashchenko O.V., Yermakova T.S., Cieślicka M., Śukowska H. [23], Khudolii O.M., Iermakov S.S., Prusik K. [26], O.M. Khudolii, O.V. Ivashchenko [16] that control over training process is more effective if training modes are determined on the base of regressive models.

Conclusions:

1. Experiment of type 2^2 permitted to study multi-factorial structure of training process of 14-15 years' old pupils; to specify factors' optimal correlations for their application in training of physical exercises at physical culture lessons. They are objective tool of educational process's optimization.
2. In respect to 14 years' old girls effectiveness of trainings is influenced by quantity of repetitions in lesson. Increase of these repetitions up to 12 influences negatively. Interaction of quantity of repetitions and rest intervals also influences on effectiveness of training process. Mastering level increases with increasing of quantity of repetitions up to 12 times and rest interval – up to 120 sec. (forced headstand and throwing of small ball).
3. In respect to 15 years' old girls effectiveness of trainings is influenced by quantity of repetitions in lesson and rest interval. Optimal conditions are created with 6 repetitions of exercise and rest interval 60 sec.
4. Results of dispersion analysis witness that for 14-15 years' old girls the most optimal modes are 6-12 repetitions of exercise and rest intervals 60 – 120 sec. In training of 14 years' old girls attention should be paid to quantity of repetitions in one lesson; for 15 years' old girls attention should be paid to increasing of rest interval.

The next task of already conducted experimental work is working out of methodic recommendations on organization and methodic of physical exercises' training of 14-15 years pupils at physical culture lessons.

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Conflict of interests

The authors declare that there is no conflict of interests.

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