

EFFECTIENESS OF JUNIOR FORM PUPILS' TRAINING OF GYMNASTIC EXERCISES IN DIFFERENT MODES OF THEIR FULFILLMENT

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Abstract. *Purpose:* determination of junior pupils' motor skills' formation. *Material:* in the research 172 pupils participated: in every parallel of forms – 48 pupils. *Results:* effectiveness of 1st form pupils' is positively influenced (exercise – forward roll) by increase of attempts up to 12 times; quantity of repetitions in one attempt shall be within 1-3. For 2nd form pupils (exercise – forward roll), 3rd form (exercise – vault over the width of gymnastic horse) and 4th form pupils (exercise – vault over width of gout with bent legs) positive influence was rendered by increase of repetitions in one attempt up to 3 times and quantity of attempts within 6-12 times. Attention shall be accentuated on quantity of exercise's repetitions in one attempt (2nd-4th forms) and quantity of attempts (4th form). *Conclusions:* Experiment of 2³ type permitted to study multi-factorial structure of modes of 1-4 forms' schoolchildren's training to physical exercises; to specify optimal correlations of quantity of attempts, quantity of repetitions in one attempt and rest interval in period of acrobatic exercises' and gymnastic vaults' training at physical culture lessons.

Key words: training, motor skills, schoolchildren, gymnastic, teaching.

Introduction

In modern conditions of weakening of schoolchildren's motor functioning, low resistance of their organisms to diseases there appears the problem of optimization of children's and adolescents' physical education (V.K. Baltsevych [1], T.Yu. Krutsevych, G.V. Bezverkhnia [12], O.M. Khudolii, O.V. Ivashchenko [35]). Effectiveness of physical education is influenced by correlation of physical exercises' training and development of motor abilities. Development of motor abilities is effective if they become a component of motor skills' mastering (A. M. Shlemin [38], M. M. Bogen [3], V. I. Liakh[15], O.M. Khudolii [26, 27, 28, 30], O.M. Khudolii O.M. Khudolii [29], D.T. Miroshnichenko [17]).

In researches of O.V. Ivashchenko [10], D.T. Miroshnichenko [17] There was regarded methodic of training of curriculum physical exercises from. In works by O.M. Khudolii [28, 30], O.M. Khudolii, S.S. Iermakov [29] laws of motor skills' formation in junior gymnasts were substantiated. For junior schoolchildren technological approaches to training of light athletic, gymnastic, acrobatic exercises, climbing the rope were offered (A. A. Zdanevich [9], D.T. Miroshnichenko [17], V. Rybalko [21], O.M. Khudolii [27], O.V. Ivashchenko [10]).

It was established that effectiveness of training increases if methods of programmed training were used (A.I.Berg, I.I. Tikhonov [2], V.P. Golubiev [4], A.M. Shlemin [38], Zh.K. Kholodov, P.N. Khlomeniuk [22], A.N. Laputin [13], P.K. Petrov, [18, 19, 20], O.M. Khudolii [27, 28], O.V. Ivashchenko [10]) and modes of exercises' and rest's alternation were considered (O.V. Ivashchenko [23], O.V. Ivashchenko [11], V. I. Miroshnichenko [16], O.V. Ivashchenko, O.V. Ivashchenko [31, 35]).

One of methods of children's and adolescents' motor skills' studying is simulation, conception of which was delivered in works by O.M. Khudolii [26], A.O. Lopatyeva [14], S.V. Dmitriyeva [5], Milić, M., Milavić, B., & Grgantov, Z. [43], O.M. Khudolii, O.V. Ivashchenko [31, 35], O.M. Khudolii [6, 7, 8], O.M. Khudolii, O.M. Khudolii [29], Ivashchenko O.V., Khudolii O.M., Yermakova T.S., Pilewska W., Muszkietka R., Stankiewicz B. [40], Ivashchenko O.V., Yermakova T.S., Cieślicka M., Zukowska H. [41], Khudolii O.M., Iermakov S.S., Prusik K. [42], Adashevskiy V. M., Iermakov S. S. [39].

In works of O.M. Khudolii, O.V. Ivashchenko [31, 35] there was studied level of physical exercises' mastering and its dynamic. For determination of training process's laws study of level increment of physical exercises' mastering as a criterion of training effectiveness is rather promising. Thus, study of junior schoolchildren's motor skills' formation is rather important and urgent.

Table 1

Matrix of 2³ type factorial experiment in studying of different modes of exercise's repetitions for level of its mastering

Experimental groups	Factors		
	x ₁ quantity of attempts (times)	x ₂ quantity of repetitions in one attempt (times)	x ₃ rest interval (sec.)
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

Purpose, tasks of the work, material and methods

The purpose of the work is determination of junior pupils’ motor skills’ formation.

The methods and organization of the work: in the work we used analysis and generalization of scientific and methodic literature data, theoretical general-scientific methods: analogy, analysis, synthesis, abstraction, induction. Besides, we used empiric general scientific methods: observation, testing, experiment.

In the process of planning of our research we used conceptual approaches to planning of experiment, which were substantiated in works of O.M. Khudolii and T.V. Karpunets [24], O.M. Khudolii and O.V. Ivashchenko [31, 35], O.M. Khudolii [26]. In dissertation works of O.M. Khudolii [28], O.V. Ivashchenko [11], V.I. Miroshnichenko [16] there was stated that control over training process would be more effective with determination of training modes on the base of regressive models by results of full factorial experiment (FFE) of type FFE 2^k.

In the research we used plans of factorial experiment of type FFE 2³ (see table 1). We researched motor modes of training: forward roll (1st, 2nd forms’ pupils); vault over width of horse (3rd form pupils); vault over width of gout with bent legs (4th form pupils). The purpose of FFE was to optimize modes of training and determine peculiarities of formation of 1st-4th form schoolchildren’s motor skills on the base of regression equations’ analysis.

In pedagogic experiment we studied influence of quantity of attempts (x₁), quantity of repetitions in one attempt (x₂) and rest intervals (x₃) on change of mastering level’s increment of 1st-4th form schoolchildren.

In the process of gymnastic exercises’ training we assessed level of mastering with alternative method (“fulfilled”, “not fulfilled”), considered probability of exercise’s fulfillment (p = n/m, where n — quantity of successfully fulfilled attempts, m — general quantity of attempts). Then we analyzed increment of mastering of gymnastic exercises.

In training of junior school age children we used method of algorithmic orders. Transition to next exercises was realized after three successful attempts. In 1st-4th forms we trained forward roll, vault over gout with legs apart and legs bent [10, 36,].

Training of forward roll was in 1st-2nd forms. *Technique of fulfillment:* forward roll – forward movement of body with full turnover and successive touching floor with shoulders and back. Forward roll is fulfilled from squat position, hands are placed at 30-40 cm from tip toes (resting on hands) unbend legs. Strongly bending back and dropping head on chest fall down ahead, bending arms. Slowing fall, softly rest on neck and blades, quickly tuck and make roll.

Training tasks:

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 apart, 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.
6. From squat position with hands on floor roll forward.
7. Make forward roll from main stance.
8. Three forward rolls at convenient temp.

Vault over width of gymnastic horse (3rd form), training tasks:

1. From lying position with hands on floor go in standing position with hands on floor, legs are wide apart and quickly straighten body.
2. From 2—3 step run jump in squat position with hands on floor and expand legs.
3. From 2—3 step run jump in standing position with hands on hours with handle, legs apart – on horse, torso is bent; dismount.
4. From squat on horse (gout) jump down with legs apart over one more horse or gout standing in front..
5. Jump from the spot with legs apart over width of horse with handle.
6. Jump from the spot with legs apart over length of gout.
7. With legs apart jump over length of gout and make bridge at 1 meter distance from apparatus.
8. The same but jump over width of horse.

Vault over width of gout with bent legs (4th form), training tasks:

1. From lying position with hands on floor, simultaneously pushing up with two arms and two legs take

squat position with arms stretched forward.

2. From squat position with hands on floor jump not loosing hands' contact with floor.
3. From, 3 meters' run jump into squat on gout with hands, touching the gout; dismount with bent legs.
4. From squat position with hands on bench, jump with bent legs over gymnastic bench.
5. From 3-5 meters' run jump over width of gout with bent legs.
6. From 5-7 meters' run jump over width of gout with bent legs, as far as possible from the apparatus.
7. From full run jump over width of gout with bent legs.
8. From full run jump over width of gout with bent legs and make bridge at distance of 1 m from the

apparatus.

In every parallel of forms 48 pupils participated in the research; in total -172 pupils.

Results of the research

Results of factorial experiment are given in table 2-3.

Table 2

Regressive dependence of fitness in gymnastic exercises on quantity of attempts (x_1), quantity of repetitions in one attempt (x_2) and rest intervals (x_3) of 1-4 form pupils

Form	Description of exercises	Regression equation for coded variables
1	1. From position sitting on floor roll back in tuck and turn in initial position.	$Y = 0,45 + 0,108x_1 + 0,078x_3$
	2. From squat position with hands on floor roll back in tuck and turn in initial position.	$Y = 0,57 - 0,063x_1x_2$
	3. From standing position with hands on floor, legs apart, make forward roll in sitting position with expanded legs.	$Y = 0,561 + 0,096x_1 + 0,056x_2$
	4. From standing position with hands on floor make forward roll in sitting position in tuck.	$Y = 0,55 + 0,091x_1$
	5. From standing position with hands on floor make forward roll in squat position with hands on floor.	$Y = 0,64 + 0,064x_1$
2	1. From sitting in tuck position roll backward and turn in initial position	$Y = 0,504 + 0,071x_2$
	2. From squat position with hands on floor roll backward in tuck and return in initial position	$Y = 0,658 + 0,095x_2$
	3. From standing position with legs apart make forward roll in sitting position with legs expanded.	$Y = 0,628 + 0,01x_2$
	4. From standing position with hands on floor and legs apart make forward roll in sitting position in tuck	$Y = 0,629 + 0,064x_1$
	5. From standing position with hands on floor and legs apart make forward roll in squat with hands on floor.	$Y = 0,663 + 0,078x_2$
3	1. From lying position with hands on floor, by pushing up with legs take standing position with hands on floor and legs expanded and quickly straighten the body	$Y = 0,636 + 0,054x_2$
	2. From 2—3 step run jump in squat position with hands on floor and legs expanded	$Y = 0,703 + 0,053x_2 - 0,08x_3$
	3. From 2—3 step run jump in standing position with hands on floor; torso is and legs apart on horse with handle and dismount arching torso	$Y = 0,711 + 0,069x_2$
	4. In squat on horse jump with legs apart over horse or gout, standing in front	$Y = 0,714 + 0,066x_2$
	5. Jump from the spot with legs apart over horse with handles	$Y = 0,663 + 0,06x_2 - 0,06x_1x_3$

Form	Description of exercises	Regression equation for coded variables
4	1. From lying position with hands on floor, simultaneously pushing up with two arms and two legs take squat position with arms stretched forward.	$Y = 0,628 + 0,07x_1 + 0,43x_2$
	2. From squat position with hands on floor jump not losing hands' contact with floor.	$Y = 0,613 + 0,055x_1 + 0,075x_2$
	3. From 3 meters' run jump into squat on gout with hands, touching the gout; dismount with bent legs.	$Y = 0,739 - 0,061x_1x_2 + 0,061x_1x_2x_3$
	4. From squat position with hands on bench, jump with bent legs over gymnastic bench.	$Y = 0,739 + 0,061x_1$
	5. From 5-7 meters' run jump over width of gout with bent legs	$Y = 0,68 + 0,05x_2 - 0,06x_1x_2$

Table 3

Results of dispersion analysis for FFE 23, which studies dependence of increment of gymnastic exercises mastering on quantity of attempts (x_1), quantity of repetitions in one attempt (x_2) and rest intervals (x_3) of 1-4 form pupils

Form	Description of exercises	Regression equation for coded variables						
		x_1	x_2	x_1x_2	x_3	x_1x_3	x_2x_3	$x_1x_2x_3$
1	1. From position sitting on floor roll back in tuck and turn in initial position.	57.42	0.77	1.98	29.84	3.1	6.08	0.77
	2. From squat position with hands on floor roll back in tuck and turn in initial position.	15.45	28.47	49.29	5.04	0.31	0.70	0.70
	3. From standing position with hands on floor, legs apart, make forward roll in sitting position with expanded legs.	50.25	17.16	10.38	15.67	1.02	4.48	1.02
	4. From standing position with hands on floor make forward roll in sitting position in tuck.	46.48	20.94	6.35	20.94	2.52	2.52	0.21
	5. From standing position with hands on floor make forward roll in squat position with hands on floor.	60.22	5.2	5.2	6.69	16.87	0.57	5.2
2	1. From sitting in tuck position roll backward and turn in initial position	10.53	40.69	1.01	10.53	19.05	1.01	17.14
	2. From squat position with hands on floor roll backward in tuck and return in initial position	0	78.35	1.35	4.39	10.63	0.86	4.39
	3. From standing position with legs apart make forward roll in sitting position with legs apart	12.36	77.25	0.43	2.36	0.19	6.95	0.43
	4. From standing position with hands on floor and legs apart make forward roll in sitting position in tuck	51.37	21.5	0.49	3.33	0.49	10.44	12.34
	5. From standing position with hands on floor and legs apart make forward roll in squat with hands on floor.	3.12	61.32	18.44	7.72	3.12	3.12	3.12
3	1. From lying position with hands on floor, by pushing up with legs take standing position	23.82	26.2	23.82	1.71	8.85	15.43	0.12

Form	Description of exercises	Regression equation for coded variables						
	with hands on floor and legs apart and quickly straighten the body							
	2. From 2—3 step run jump in squat position with hands on floor and legs apart	12.27	18.72	0.04	43.48	4.24	16.98	4.24
	3. From 2—3 step run jump in standing position with hands on floor; torso is and legs apart on horse with handle and dismount arching torso	7.26	60.9	7.26	2.43	0.18	14.67	7.26
	4. In squat on horse jump with legs apart over horse or gout, standing in front	10.36	55.04	10.36	0.01	3.31	4.4	16.48
	5. Jump from the spot with legs apart over horse with handles	23.37	25.64	5.29	1.90	30.52	8.95	4.29
4	1. From lying position with hands on floor, simultaneously pushing up with two arms and two legs take squat position with arms stretched forward.	58.55	21.58	10.75	2.68	1.86	2.68	1.86
	2. From squat position with hands on floor jump not losing hands' contact with floor.	26.37	49.04	2.67	2.67	3.48	3.48	12.26
	3. From 3 meters' run jump into squat on gout with hands, touching the gout; dismount with bent legs.	9.6	9.6	31.62	14.34	1.59	1.59	31.62
	4. From squat position with hands on bench, jump with bent legs over gymnastic bench.	73.04	10.98	10.98	0.27	0.27	0.76	3.68
	5. From 5-7 meters' run jump over width of gout with bent legs	9.85	23.32	33.58	9.85	9.85	11.42	2.09

Increment of *first form* pupil' mastering of *first* task (from position sitting on floor roll back in tuck and turn in initial position) is positively influenced by quantity of attempts (x_1) and rest interval (x_3) (see table 2). Increment of *first form* pupil' mastering of *second* task (from squat position with hands on floor roll back in tuck and turn in initial position) is negatively influenced by interaction of quantity of attempts and quantity of repetitions (x_1x_2). Increment of *first form* pupil' mastering of *third* task (from standing position with hands on floor, legs apart, make forward roll in sitting position with expanded legs) is positively influenced by quantity of attempts (x_1) and quantity of repetitions (x_2). Increment of mastering of *forth* task (from standing position with hands on floor make forward roll in sitting position in tuck) is positively influenced by quantity of attempts (x_1). Increment of *fifth* task mastering (from standing position with hands on floor make forward roll in squat position with hands on floor) is positively influenced by quantity of attempts (x_1).

Thus, effectiveness of *first form* pupils' training of forward roll is positively influenced by the following: quantity of attempts up to 12 times; quantity of repetitions in one attempt – up to 1-3 times; rest interval - 60—180 sec. In process of training attention should be accentuated on quantity of attempts.

Increment of *second form* pupil' mastering of *first* task (from sitting in tuck position roll backward and turn in initial position) is positively influenced by quantity of attempts (x_1). Increment of *second form* pupil' mastering of *second* task (from squat position with hands on floor roll backward in tuck and return in initial position) is positively influenced by quantity of repetitions in one attempt (x_2). Increment of *third* task mastering (from standing position with legs apart make forward roll in sitting position with legs apart) is positively influenced by quantity of repetitions in one attempt (x_2). Increment of *forth* task mastering (from standing position with hands on floor and legs apart make forward roll in sitting position in tuck) is positively influenced by quantity of attempts (x_1). Increment of *fifth* task mastering (from standing position with hands on floor and legs apart make forward roll in squat with hands on floor) is positively influenced by quantity of repetitions in one attempt (x_2).

Thus, effectiveness of *second form* pupils' training of forward roll is positively influenced by the following: quantity of attempts up to 6 - 12 times; quantity of repetitions in one attempt – up to 3 times; rest interval - 60—180 sec. In process of training attention should be accentuated on quantity of repetitions in one attempt.

Increment of *third form* pupils' mastering of *first* task in training of “vault over width of gymnastic horse with legs apart” (from lying position with hands on floor, by pushing up with legs take standing position with hands on floor

and legs expanded and quickly straighten the body) is positively influenced by quantity of repetitions in one attempt (x_2). Increment of *third form* pupil' mastering of *second* task (from 2—3 step run jump in squat position with hands on floor and legs apart) is positively influenced by quantity of repetitions in one attempt and negatively - by rest interval (x_3). Increment of *third* task mastering (from 2—3 step run jump in standing position with hands on floor; torso is and legs are expanded on horse with handle and dismount arching torso) is positively Influenced by quantity of repetitions (x_2). Increment of *forth* task mastering (in squat on horse jump with expanded legs over horse or gout, standing in front) is positively influenced by quantity of repetitions in one attempt (x_2). Increment of *fifth* task mastering (jump from the spot with expanded legs over horse with handles) is positively influenced by quantity of repetitions (x_2) and interaction of quantity of attempts with rest intervals (x_1x_3).

Thus, effectiveness of *third form* pupils' training of "vault over width of gymnastic horse with legs apart" is positively influenced by the following: quantity of attempts up to 6 - 12 times; quantity of repetitions in one attempt – up to 3 times; rest interval - 60—180 sec. In process of training attention should be accentuated on quantity of repetitions in one attempt.

Increment of *forth form* pupils' mastering of *first* task in training of "vault over width of gout" (from lying position with hands on floor, simultaneously pushing up with two arms and two legs take squat position with arms stretched forward) is positively influenced by quantity of attempts (x_1) and quantity of repetitions in one attempt (x_2). Increment of *forth form* pupils' mastering of *second* task (from squat position with hands on floor jump not losing hands' contact with floor) is positively influenced by quantity of attempts (x_1) and quantity of repetitions in one attempts (x_2). Increment of *forth form* pupils' mastering of *third* task (from 3 meters' run jump into squat on gout with hands, touching the gout; dismount with bent legs) is positively influenced by interaction of quantity of attempts with quantity of repetitions in one attempt (x_1x_2) and interaction of quantity of attempts, quantity of repetitions in one attempt and rest interval ($x_1x_2x_3$). Increment of *forth* task mastering (from squat position with hands on bench, jump with bent legs over gymnastic bench) is positively influenced by quantity of attempts (x_1). Increment of *fifth* task mastering (from 5-7 meters' run jump over width of gout with bent legs) is positively influenced by quantity of repetitions in one attempt (x_2), and negatively – by interaction of quantity of attempts with quantity of repetitions in one attempt (x_1x_2).

Thus, effectiveness of *forth form* pupils' training of "vault over width of gout" is positively influenced by the following: quantity of attempts up to 6 - 12 times; quantity of repetitions in one attempt – up to 3 times; rest interval - 60—180 sec. In process of training attention should be accentuated on quantity of repetitions in one attempt and on quantity of attempts.

Results of dispersion analysis for FFE 2³ are given in table 3.

Increment of first form pupils' mastering (forward roll) of first task "from position sitting on floor roll back in tuck and turn in initial position" is influenced by quantity of attempts - by 57.42% (x_1) and by rest interval – by 29.84% (x_3) (see table 3, fig.1). Increment of second task's mastering ("from squat position with hands on floor roll back in tuck and turn in initial position") is influenced by interaction of quantity of attempts and quantity of repetitions in one attempt - by 49.29% (x_1x_2), by 28.47% — by quantity of repetitions in one attempt (x_2), by 15.45% — by quantity of attempts (x_1). Increment of third task's mastering ("from standing position with hands on floor, legs apart, make forward roll in sitting position with legs apart") by 50.25% is influenced by quantity of attempts (x_1), by 17.16% — by quantity of repetitions in one attempt (x_2), by 15.67% — by rest interval (x_3). Increment of forth task's mastering ("from standing position with hands on floor make forward roll in sitting position in tuck") by 46.68% is influenced by quantity of attempts (x_1), by 20.94% — by quantity of repetitions in one attempt (x_2), by 20.94% — by rest interval (x_3). Increment of fifth task's mastering ("from standing position with hands on floor make forward roll in squat position with hands on floor") by 60.22% is influenced by quantity of attempts (x_1), by 16.87 — by interaction of quantity of attempts with rest interval x_1x_3).

Thus, effectiveness of *first form* pupils' training of forward roll by 15-60% is influenced by the following: quantity of attempts up to 12 times; quantity of repetitions in one attempt – up to 1-3 times; rest interval - 60—180 sec. In process of training attention should be accentuated on quantity of attempts.

Increment of second form pupils' (forward roll) mastering of *first* task ("from sitting in tuck position roll backward and turn in initial position") by 40.69% is influenced by quantity of repetitions in one attempt (x_2). Increment of second form pupils' mastering of *second* task ("from squat position with hands on floor roll backward in tuck and return in initial position") by 78.35% is influenced by quantity of repetitions in one attempt (x_2). Increment of third task's mastering of ("from standing position with legs apart make forward roll in sitting position with legs apart") by 77.25% is influenced by quantity of repetitions in one attempt (x_2). Increment of forth task's mastering of ("from standing position with hands on floor and legs apart make forward roll in sitting position in tuck") by 51.37% is influenced by quantity of attempts (x_1), by 21.5% — by quantity of repetitions in one attempt (x_2). Increment of fifth task's mastering of ("from standing position with hands on floor and legs apart make forward roll in squat with hands on floor") by 61.32% is influenced by quantity of repetitions in one attempt (x_2).

Thus, effectiveness of *second form* pupils' training of forward roll by 40.69—78.35% is influenced by the following: quantity of attempts up to 6 - 12 times; quantity of repetitions in one attempt – up to 3 times; rest interval - 60—180 sec. In process of training attention should be accentuated on quantity of repetitions in one attempt.

Increment of third form pupils' ("vault over width of gymnastic horse with legs apart") mastering of *first* task ("from lying position with hands on floor, by pushing up with legs take standing position with hands on floor and legs apart and quickly straighten the body") by 26.2% is influenced by quantity of repetitions in one attempt (x_2), by 23.82%

— by quantity of attempts (x_1), by 23.82% — by rest interval (x_3). Increment of third form pupils' mastering of *second* task ("from 2—3 step run jump in squat position with hands on floor and legs apart") by 43.48% is influenced by rest interval (x_3), by 18.72% — by quantity of repetitions in one attempt (x_2). Increment of *third* task's mastering of ("from 2—3 step run jump in standing position with hands on floor; torso is and legs apart on horse with handle and dismount arching torso") by 60.9% is influenced by quantity of repetitions in one attempt (x_2). Increment of *fourth* task's mastering of ("in squat on horse jump with legs apart over horse or gout, standing in front") by 50.4% is influenced by quantity of repetitions in one attempt (x_2). Increment of *fifth* task's mastering by 25.64% is influenced by quantity of repetitions (x_2), by 30.52% — by interaction of quantity of attempts with rest intervals (x_1x_3).

Thus, effectiveness of *third form* pupils' training of "vault over width of gymnastic horse with legs apart" is positively influenced by the following: quantity of attempts up to 6 - 12 times; quantity of repetitions in one attempt – up to 3 times; rest interval - 60—180 sec. In process of training attention should be accentuated on quantity of repetitions in one attempt.

Increment of *fourth form* pupils' ("vault over width of gout") mastering of *first* task ("from lying position with hands on floor, simultaneously pushing up with two arms and two legs take squat position with arms stretched forward") by 58.55% is influenced by quantity of attempts (x_1), by 21.58% — by quantity of repetitions in one attempt (x_2). Increments of *second* task's mastering of ("from squat position with hands on floor jump not losing hands' contact with floor") by 26.37% is influenced by quantity of attempts (x_1), by 49.04% — by quantity of repetitions in one attempts (x_2). Increment of *third* task's mastering of ("from 3 meters' run jump into squat on gout with hands, touching the gout; dismount with bent legs") by 31.62% is influenced by interaction of quantity of attempts with quantity of repetitions in one attempt (x_1x_2), by 31.62% — by interaction of quantity of attempts, quantity of repetitions in one attempt and rest interval ($x_1x_2x_3$). Increment of *fourth* task's mastering of ("from squat position with hands on bench, jump with bent legs over gymnastic bench") by 73.04% is influenced by quantity of attempts (x_1). Increment of *fifth* task's mastering of ("from 5-7 meters' run jump over width of gout with bent legs") by 23.32% is influenced by quantity of repetitions in one attempt (x_2), by 23.32% — by interaction of quantity of attempts with quantity of repetitions in one attempt (x_1x_2).

Thus, effectiveness of *fourth form* pupils' training of "vault over width of gout" is positively influenced by the following: quantity of attempts up to 6 - 12 times; quantity of repetitions in one attempt – up to 3 times; rest interval - 60—180 sec. In process of training attention should be accentuated on quantity of repetitions in one attempt and on quantity of attempts.

Discussion

Results of the research permitted to supplement the data about planning of experiment in studying of training process's effectiveness and working out of training models (O.M. Khudolii, T.V. Karpunets [24]; O.M. Khudolii, O.V. Ivashchenko [31, 35]; O.M. Khudolii, O.V. Ivashchenko, S.O. Chernenko [32, 33]). We have confirmed that control over training process is more effective with specifying of training modes on the base of regressive models by full factorial experiment of FFE 2^k type (O.M. Khudolii [28], O.V. Ivashchenko [11]; V.I. Miroshnichenko [16]).

We also supplemented the data of O.M. Khudolii and O.V. Ivashchenko [31, 35] about possibility to use level of mastering of physical exercises and its dynamic for assessment of training effectiveness. It was established that for obtaining objective information about training process studying of physical exercises' mastering level's increment is promising as a criterion of assessment of training effectiveness.

The novelty is the data about modes of gymnastic training of 1st-4th form pupils.

Conclusions:

Experiment of 2^3 type permitted to realize the following: study multi-factorial structure of modes of 1st-4th form pupils' training of physical exercises; to specify optimal correlations of quantity of attempts, quantity of repetitions in one attempt and rest intervals.

Effectiveness of *first form* pupils' training of forward roll is positively influenced by the following: quantity of attempts up to 12 times; quantity of repetitions in one attempt – up to 1-3 times; rest interval - 60—180 sec. In process of training attention should be accentuated on quantity of attempts.

Effectiveness of *second form* pupils' training of forward roll by 40.69—78.35% is influenced by the following: quantity of attempts up to 6 - 12 times; quantity of repetitions in one attempt – up to 3 times; rest interval - 60—180 sec. In process of training attention should be accentuated on quantity of repetitions in one attempt.

Effectiveness of *third form* pupils' training of "vault over width of gymnastic horse with legs apart" is positively influenced by the following: quantity of attempts up to 6 - 12 times; quantity of repetitions in one attempt – up to 3 times; rest interval - 60—180 sec. In process of training attention should be accentuated on quantity of repetitions in one attempt.

Effectiveness of *fourth form* pupils' training of "vault over width of gout" is positively influenced by the following: quantity of attempts up to 6 - 12 times; quantity of repetitions in one attempt – up to 3 times; rest interval - 60—180 sec. In process of training attention should be accentuated on quantity of repetitions in one attempt and on quantity of attempts.

The prospects of further researches are determination of training modes' influence on dynamic of indicators of motor skills' progressing in junior school age children.

References:

1. Bal'sevich VK. *Ontokineziologiya cheloveka* [Onto kinesiology human], Moscow: Theory and practice of physical culture; 275. (in Russian)
2. Berg AI, Tikhonov II. *Problemy programmirovannogo obucheniia* [Problems of programmed teaching], Leningrad: Knowledge; 1968. (in Russian)
3. Bogen MM. *Obuchenie dvigatel'nykh deistviiam* [Training of motor actions], Moscow: Physical Culture and Sport; 1985. (in Russian)
4. Golubev VP. Programmirovannoe obuchenie v teorii i praktike fizicheskogo vospitaniia studentov [Programmed training in theory and practice of students' physical education]. *Teoriia i praktika fizicheskoi kul'tury* 1969;6:50–52. (in Russian)
5. Dmitriev SV. Proektno-tehnologicheskoe modelirovanie dvigatel'nykh deistvii — didakticheskie osnovy [Projecting-technological simulation of motor actions – didactic principles], *Physical education of students* 2008;2:17–32. (in Russian)
6. Iermakov S. Modeli biomekhanicheskikh sistem v organizacii effektivnogo deistviia sportsmena [Models of bio-mechanical systems in organization of sportsman's effective functioning]. *Pedagogics, psychology, medical-biological problems of physical training and sports* 2001;17:40–47. (in Russian)
7. Iermakov SS. Modeli rabochikh poz sportsmena kak faktor effektivnosti vypolneniia dvigatel'nykh deistvii [Models of working postures as factor of effectiveness of motor actions' fulfillment]. *Fizicheskoe vospitanie studentov tvorcheskikh special'nostej* 2001;4:16–22. (in Russian)
8. Iermakov SS. Biomekhanichni modeli udarnikh rukhiv u sportivnikh igrakh u konteksti vdoskonalennia tekhnichnoi pidgotovki sportsmeniv [Bio-mechanical models of strike movements in context of perfection of sportsmen technical fitness]. *Teoriia ta praktika fizichnogo vikhovannia* 2010;4:11–18. (in Ukrainian)
9. Zdanevich AA. U mladshikh shkol'nikov — metanie v cel' [For junior pupils – throwing into target]. *Fizicheskaia kul'tura v shkole* 1995;1:13–16. (in Russian)
10. Ivashchenko OV. Metodika navchannia gimnastichnim vpravam shkil'noi programi [Methodic of gymnastic exercises' training in school program]. *Teoriia ta praktika fizichnogo vikhovannia* 2001;1:26–31. <http://dx.doi.org/10.17309/tmfv.2001.1.7> (in Ukrainian)
11. Ivashchenko O. V. *Normativnye pokazateli trenirovochnykh nagruzok na nachal'nom etape podgotovki iunykh gimnastok 6–8 let. Cand. Diss.* [Normative indicators of training loads at initial stage of junior, 6-8 yrs., girl-gymnasts], Moscow; 1988. (in Russian)
12. Krucevich TIu, Bezverkhnia GV. *Rekreaciia u fizichnij kul'turi riznikh grup naseleunia* [Recreation in physical education of different population groups], Kiev: Olympic Literature; 2010. (in Ukrainian)
13. Laputin AN. *Obuchenie sportivnym dvizheniiam* [Training of sport movements], Kiev: Health; 1986. (in Russian)
14. Lopat'iev A. O. Modeliuvannia iak metodologiya piznannia [Simulation as cognitive methodology]. *Teoriia ta metodika fizichnogo vikhovannia* 2007;8:4–10. (in Ukrainian)
15. Liakh VI. *Dvigatel'nye sposobnosti* [Motor abilities]. *Fizicheskaia kul'tura v shkole* 1996;2:C. 2–6. (in Russian)
16. Miroshnichenko VI. *Metodika formirovaniia dvigatel'nykh navykov u detej mladshogo shkol'nogo vozrasta. Cand. Diss.* [Methodic of motor skills' formation in junior school age children. Cand. Diss.], Moscow; 1988. (in Russian)
17. Miroshnichenko DT. Metodika navchannia akrobaticnim vpravam uchniv molodshikh klasiv [Methodic of junior form pupils' training to acrobatic exercises]. *Teoriia ta metodika fizichnogo vikhovannia* 2007;12:29–31. (in Ukrainian)
18. Petrov PK. *Sistema podgotovki budushchikh specialistov fizicheskoi kul'tury v usloviakh informatizacii obrazovaniia. Dokt. Diss.* [System of training of future physical culture specialists in conditions of increasing of information's role in education. Dokt. Diss.], Izhevsk; 2004. (in Russian)
19. Petrov PK. *Informacionnye tekhnologii v fizicheskoi kul'ture i sporte* [Information technologies in physical culture and sports], Moscow: Academy; 2013. (in Russian)
20. Petrov PK. *Osnovy programmirovannogo obucheniia v fizicheskoi vospitanii* [Principles of programmed training in physical education], Ustinov; 1987. (in Russian)
21. Ribalko V. Navchannia tekhniki metannia m'iacha na urokakh fizichnoi kul'turi [Training of ball throwing technique at physical culture lessons]. *Fizichne vikhovannia v shkoli* 2005;5:27–31. (in Ukrainian)
22. Kholodov ZhK, Khlomenok PN. Aktual'nye voprosy algoritimizacii i programmirovaniia obucheniia [Urgent problems of algorithm provisioning and programming of teaching]. *Teoriia i praktika fizicheskoi kul'tury* 1979;9:51–53. (in Russian)
23. Khudolij OM. Navantazhennia u sportivnomu trenuvanni iunikh gimnastiv [Loads in sport training of junior gymnasts]. *Teoriia ta metodika fizichnogo vikhovannia* 2001;3:13–19. (in Ukrainian)
24. Khudolij OM, Karpunec' TV. Planuvannia eksperimentu v doslidzhenni procesu pidgotovki iunikh gimnastiv [Planning of experiment in study of junior gymnasts' training]. *Teoriia ta metodika fizichnogo vikhovannia* 2002;4:2–8. <http://dx.doi.org/10.17309/tmfv.2002.4.73> (in Ukrainian)
25. Khudolij OM, Ivashchenko OV. Konceptual'ni pidkhodi do rozrobki programi naukovikh doslidzen' u fizichnomu vikhovanni [Conceptual approaches to working out of program of scientific researches in physical

- education]. *Teoriia ta metodika fizichnogo vikhovannia* 2004;4:2—5. <http://dx.doi.org/10.17309/tmfv.2004.4.140> (in Ukrainian)
26. Khudolii ON. *Modelirovanie processa podgotovki iunikh gimnastov* [Simulation of junior gymnasts' training process], Kharkov: OVS; 2005. (in Russian)
 27. Khudolii OM. Tekhnologiiia navchannia gimnastichnim vpravam. Dopovid' 1 [Technology of gymnastic exercises' training. Report 1]. *Teoriia ta metodika fizichnogo vikhovannia* 2009;8:19—34. <http://dx.doi.org/10.17309/tmfv.2009.9.562> (in Ukrainian)
 28. Khudolii OM. *Teoretiko-metodichni zasadi sistemi pidgotovki iunikh gimnastiv 7—13 rokiv. Dokt. Diss.* [Theoretical-methodic principles of system of junior, 7-13 yrs. age, gymnasts' training Dokt. Diss.], Kiev; 2011. (in Ukrainian)
 29. Khudolii OM, Iermakov SS. Zakonomirnosti procesu navchannia iunikh gimnastiv [Training process of junior gymnasts]. *Teoriia ta metodika fizichnogo vikhovannia* 2011;5:3—18. <http://dx.doi.org/10.17309/tmfv.2011.5.707> (in Ukrainian)
 30. Khudolii OM. Zakonomernosti formirovaniia dvigatel'nykh navykov u iunikh gimnastov [Regularities of motor skills' formation in junior gymnasts]. *Nauka v olimpijskom sporte* 2012;1:36—46 (in Russian)
 31. Khudolii OM, Ivashchenko OV. Konceptual'ni pidkhodi do modeliuвання процесу навчання і розвитку рухових здібностей у дітей і підлітків [Conceptual approaches to simulation of training process and development of children's and adolescents' motor skills]. *Teoriia ta metodika fizichnogo vikhovannia* 2013;2:3—16. <http://dx.doi.org/10.17309/tmfv.2013.2.1012>(in Ukrainian)
 32. Khudolii OM, Ivashchenko OV, Chernenko SO. Chinniki, shcho vplivaiut' na efektyvnist' navchannia fizichnim vpravam khlopchikiv molodshikh klasiv [Factors, influencing on effectiveness of physical exercises' training of junior form boys]. *Teoriia ta metodika fizichnogo vikhovannia* 2013;1:21—26. <http://dx.doi.org/10.17309/tmfv.2013.1.1006>(in Ukrainian)
 33. Khudolii OM, Ivashchenko OV, Chernenko SO. Chinniki, shcho vplivaiut' na efektyvnist' navchannia fizichnim vpravam divchatok molodshikh klasiv [Factors, influencing on effectiveness of physical exercises' training of junior form girls]. *Teoriia ta metodika fizichnogo vikhovannia* 2013;2:43—47. <http://dx.doi.org/10.17309/tmfv.2013.2.1016>(in Ukrainian)
 34. Khudolii OM, Ivashchenko OV. Informacijne zabezpechennia procesu navchannia i rozvitku ruхових здібностей дітей і підлітків (на приклади спортивної гімнастики) [Informational provisioning of training process and development of children's and adolescents, motor skills (on example of calisthenics)]. *Teoriia ta metodika fizichnogo vikhovannia* 2013;4:3—18. <http://dx.doi.org/10.17309/tmfv.2013.4.1031> (in Ukrainian)
 35. Khudolii OM, Ivashchenko OV. *Modeliuвання процесу навчання та розвитку рухових здібностей у дітей і підлітків* [Simulation of training process and development of children's and adolescents' motor skills], Kharkov: OVS, 2014. (in Ukrainian)
 36. Khudolii OM, Ivashchenko OV. *Teoriia ta metodika vkladannia gimnastiki* [Theory and methodic of gymnastic's training], Kharkov: OVS, 2014. (in Ukrainian)
 37. Khudolii OM, Ivashchenko OV. *Osnovi naukovo-doslidnoi roboti u fizichnomu vikhovanni i sporti* [Principles of scientific research work in physical education and sports], Kharkov: OVS, 2014. (in Ukrainian)
 38. Shlemin AM. Formirovanie u detej dvigatel'noj funktsii [Formation of children's motor function], *Fizicheskaiia kul'tura v shkole* 1983;1:13– 14. (in Russian)
 39. Adashevskiy VM, Iermakov SS, Firsova IuIu. Physical mathematical modelling of difficult elements of acrobatic rock-and-roll. *Physical Education of Students* 2013;3:3-10. <http://dx.doi.org/10.6084/m9.figshare.662463>
 40. Ivashchenko OV, Khudolii OM, Yermakova TS, Pilewska Wiesława, Muszkieta Radosław, Stankiewicz Błazej. Simulation as method of classification of 7-9th form boy pupils' motor fitness. *Journal of Physical Education and Sport (JPES)* 2015;15(1):142-147. <http://dx.doi.org/10.7752/jpes.2015.01023>
 41. Ivashchenko OV, Yermakova TS, Cieślicka M, Zukowska H. Discriminant analysis in classification of motor fitness of 9-11 forms' juniors. *Journal of Physical Education and Sport (JPES)* 2015;15(2):238 – 244. <http://dx.doi.org/10.7752/jpes.2015.02037>
 42. Khudolii OM, Iermakov SS, Prusik K. Classification of motor fitness of 7-9 years old boys. *Journal of Physical Education and Sport (JPES)* 2015;15(2): 245 - 253. <http://dx.doi.org/10.7752/jpes.2015.02038>
 43. Milić M, Milavić B, Grgantov Z. Relations between sport involvement, self-esteem, sport motivation and types of computer usage in adolescents. *Anthropological Aspects of Sport, Physical Education and Recreation. Proceedings of 3rd International Scientific Congress.* Banja Luka: University of Banja Luka; 2011. p. 151-156.

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