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MOTOR SKILLS DEVELOPMENT: PECULIARITIES OF PROGRAMMED TEACHING OF ACROBATIC EXERCISES TO GIRLS AGED 15

Alina Shuieva[1ABCDE], Olha Ivashchenko[1ABCDE], Wladyslaw Jagiello[2ACDE]

[1]H. S. Skovoroda Kharkiv National Pedagogical University
[2]Gdansk University of Physical Education and Sport

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Corresponding Author: Olha Ivashchenko, E-mail: ivashchenko@hnpu.edu.ua
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Abstract

The purpose of the study was to determine the peculiarities of programmed teaching of a cartwheel to girls aged 15.

Materials and methods. The study participants were 20 girls aged 15. The children and their parents were fully informed about all the features of the study and gave their consent to participate in the experiment. To solve the tasks set, the following research methods were used: study and analysis of scientific and methodological literature; pedagogical observation, timing of training tasks; pedagogical experiment, methods of mathematical statistics, factor analysis, nearest neighbor analysis.

Results. The analysis of similarities revealed that the program components are interrelated. Series of training tasks IV, V and VI have the highest correlation. Series of training tasks I, III and IV are combined into one group and provide conditions for teaching girls aged 15 the cartwheel.

Conclusions. The study obtained factor models of the teaching program, which explain 70.645% and 68.468% of the variation of results. The models characterize the two-factor structure of the teaching program where training tasks are closely connected with one another, which indicates their effective selection. It was found that the tasks of series I, II and III, and the tasks of series III, IV and V are most connected with one another, which confirms the combined nature of the method of algorithmic instructions. Optimization of the number of repetitions of the entire exercise (series of tasks VI) depends on the amount of exercises of the second and fifth series of training tasks.

Keywords: programmed teaching, method of algorithmic instructions, acrobatic exercises, girls.

Introduction

Developing technological approaches to motor skills development and studying their effectiveness is one of the relevant problems of schoolchildren's physical education. (Ivashchenko, 2020; Khudolii, Iermakov, & Bartik, 2020; Marchenko, & Kovalenko, 2020). The educational process uses linear, branching (Gaverdovskii, 2007; Ivashchenko, V. P., 2004; Yanchenko, 2016), and combined materials of programmed instruction (Shlemin, 1973; Khudolii, 2008; Ivashchenko, 2016).

Programmed instruction was developed in the 1970s and was based on the ideas of behaviorism (Skinner, 1965, 1984a,b; Fishman, Keller, & Atkinson, 1968). In physical education, studies in the field of programmed teaching aimed to develop teaching programs and determine their effectiveness (Berg, & Tikhonov, 1968; Golubev, 1969; Malinovskii, 1972). The following rules for building programs were defined: a) material is sequentially dosed in the form of appropriate portions; b) transition to the next portion is made after reaching a certain level; c) the program is presented in the form of a series of "steps" having a certain focus; d) materials of each "step" are presented in the form of "frames" (operational, informative, control frames) (Shlemin, 1973; Laputin, 1986).

One of the effective methods of programming is the method of algorithmic instructions. It belongs to combined methods of programmed instruction and has all the features of technology (Shlemin, 1973; Khudolii, 2008; Ivashchenko, 2016).

Therefore, the study of the peculiarities of using the method of algorithmic instructions when teaching physical exercises is relevant.

The purpose of the study was to determine the peculiarities of programmed teaching of a cartwheel to girls aged 15.

Material and methods

Study participants

The study participants were 20 girls aged 15. The children and their parents were fully informed about all the features of the study and gave their consent to participate in the experiment.

Organization of the study

To solve the tasks set, the following research methods were used: study and analysis of scientific and methodological literature; pedagogical observation, timing of training tasks; pedagogical experiment, methods of mathematical statistics, factor analysis, nearest neighbor analysis.

The pedagogical experiment examined the influence of 6 and 12 repetitions with a 60-second rest interval during a physical education class on the number of repetitions of training tasks to the 100% level of proficiency. In the first group (n = 10), the girls repeated the tasks 6 sets 1 time each with a rest interval of 60 s, in the second group (n = 10) – 6 sets 2 times each with a rest interval of 60 s.

During teaching, the method of algorithmic instructions was used (Shlemin, 1973). The program of teaching the cartwheel included the training tasks given in Table 1. It was developed based on the data of Shlemin (1973), Khudolii (2008). The next exercise started on condition of correct performance of the previous exercise on three consecutive attempts. The number of repetitions required for correct performance on three consecutive attempts was recorded.

Statistical analysis

The study materials were processed using the IBM SPSS 20 statistical analysis program. Factor analysis and nearest neighbor analysis were used.

The study protocol was approved by the Ethical Committee of the University. In addition, the children and their

Table 1. Program of teaching the cartwheel to girls aged 15 (Shlemin, 1973, Khudolii, 2008)

Informative frame (what is performed)	Operational frame (how it is performed)	Control frame (transition to training the next exercise)
The first series of training tasks – exercises to develop motor abilities		
From normal standing position, lean forward, touch the floor with the hands and, moving the hands forward on the floor, adopt a push-up position, return to starting position in the same way	When performing the exercise, do not bend the knees	If the student performs three times in 10 seconds, proceed to the next exercise
Perform push-ups as quickly as possible (5 times in 3-4 s)	Perform the exercise as quickly as possible, maintaining a gymnastic style	If the student performs the exercise in 3-4 seconds, proceed to the next exercise
The second series of training tasks – exercises to master starting and ending positions		
From standing position with raised arms, step forward and perform a switch leg handstand with assistance	Switch leg handstand	Correct performance on 3 consecutive attempts
Handstand with legs apart with assistance	Switch leg handstand, maintaining balance for 3-4 seconds	Correct performance on 3 consecutive attempts
The third series of training tasks – actions without which it is impossible to perform the target exercise		
Standing on hands with legs apart with assistance, shift the body weight from one hand to the other	Perform everything only with assistance	Correct performance on 3 consecutive attempts
The fourth series of training tasks – teaching the ability to assess movements in space, by time and muscular effort		
Arriving to handstand quickly with assistance	Pay attention to the technique of performance	Correct performance on 3 consecutive attempts
Arriving to handstand slowly with assistance	Pay attention to the technique of performance	Correct performance on 3 consecutive attempts
The fifth series of training tasks – preliminary exercises		
Arriving to handstand quickly with the wall support	Maintain balance for 3-4 seconds	Correct performance on 3 consecutive attempts
Handstand with legs apart with 90-degree rotation with assistance	Perform all exercises for this element only with assistance	Correct performance on 3 consecutive attempts
The sixth series of training tasks – the entire exercise		
Cartwheel with assistance	Pay attention to the technique of performance	Correct performance on 3 consecutive attempts
Cartwheel without assistance	Maintain a gymnastic style	Correct performance on 3 consecutive attempts

Table 2. Analysis of the effectiveness of the program of teaching girls aged 15 the cartwheel, using different repetition modes (1 – mode of 6 sets 1 time each with a rest interval of 60 s; 2 – mode of 6 sets 2 times each with a rest interval of 60 s)

Indicator		n	M	SD	t-test for Equality of Means					
					t	p	MD	SED	95% Confidence Interval of the Difference	
									Lower	Upper
Total number of repetitions	1	10	52.1	2.23	0.424	0.05	0.5	1.179	-2.99327	1.99327
	2	10	52.6	2.98						

parents or legal guardians were fully informed about all the features of the study, and a signed informed consent document was obtained from all the parents.

Results

Table 2 shows the results of a comparative analysis of the effectiveness of the program of teaching girls aged 15 the cartwheel, using different repetition modes. The null hypothesis about equality of learning outcomes is accepted ($p < 0.05$).

Structural analysis of the program of teaching girls aged 15 the cartwheel (mode of 6 sets 1 time each with a rest interval of 60 s)

As a result of analysis, two factors that explain 70.645% of the variation of results were identified (Table 3). The first factor explains 41.531% of the variation of learning outcomes. The series that are most correlated with the factor are: Series 6 – the entire exercise (r = 0.967), Series 2 – exercises to master starting and ending positions (r = -0.788), Series 5 – preliminary exercises (r = -0.718). The factor is bipolar and indicates that optimization of the number of repetitions

Table 3. Results of factor analysis of the teaching program (6 repetitions, rest interval of 60 s). Rotated Component Matrix

Series of training tasks	Component		h^2
	1	2	
Series I – exercises to develop motor abilities		0.482	0.245
Series II – exercises to master starting and ending positions	-0.788		0.624
Series III – actions without which it is impossible to perform the target exercise	0.580	-0.620	0.721
Series IV – exercises to master the ability to control movements		0.852	0.798
Series V – preliminary exercises	-0.718	0.631	0.914
Series VI – the entire exercise	0.967		0.937

Table 4. Total Variance Explaineda

Component	Rotation Sums of Squared Loadings	
	% of Variance	Cumulative %
1	41.531	41.531
2	29.114	70.645

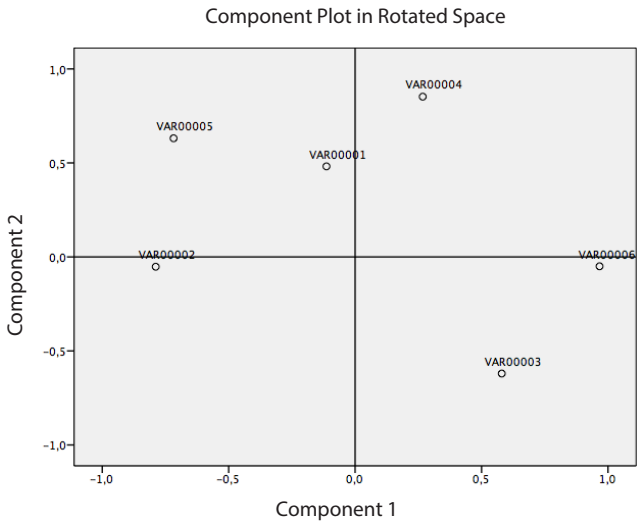

Fig. 1. Results of factor analysis of the teaching program (6 repetitions, rest interval of 60 s)

of the entire exercise depends on the amount of exercises of the second and fifth series of training tasks.

The second factor explains 29.114% of the variation of learning outcomes. The series that are most correlated with the factor are: Series 4 – exercises to master the ability to control movements (r = 0.852), Series 5 – preliminary exercises (r = 0.631), Series 3 – actions without which it is impossible to perform the target exercise (r = -0.620). The factor can be interpreted as movement control.

The analysis of similarities revealed that the program components are interrelated (Table 3). Series of training tasks IV, V and VI have the highest correlation and provide conditions for teaching girls aged 15 the cartwheel (Fig. 1).

Structural analysis of the program of teaching girls aged 15 the cartwheel (mode of 6 sets 2 times each with a rest interval of 60 s)

As a result of analysis, two factors that explain 68.468% of the variation of results were identified (Table 5). The first factor explains 42.092% of the variation of learning outcomes. The series that are most correlated with the factor are: Series I – exercises to develop motor abilities (r = 0.858), Series III – actions without which it is impossible to perform the target exercise (r = 0.869), Series IV – exercises to master the ability to control movements (r = 0.752). The factor characterizes the use of the following methods: combination (Series I), method of solving separate tasks (Series III), and method of immediate information about the exercise performance (Series IV).

Table 5. Results of factor analysis of the teaching program (12 repetitions, rest interval of 60 s). Rotated Component Matrix

Series of training tasks	Component		h^2
	1	2	
Series I – exercises to develop motor abilities	0.858		0.796
Series II – exercises to master starting and ending positions		-0.758	0.591
Series III – actions without which it is impossible to perform the target exercise	0.869		0.769
Series IV – exercises to master the ability to control movements	0.752	-0.306	0.658
Series V – preliminary exercises	-0.449	0.692	0.681
Series VI – the entire exercise	0.500	0.602	0.612

Table 6. Total Variance Explained

Component	Rotation Sums of Squared Loadings	
	% of Variance	Cumulative %
1	42.092	42.092
2	26.377	68.468

The second factor explains 26.377% of the variation of learning outcomes. The series that are most correlated with the factor are: Series II – exercises to master starting and ending positions (r = -0.758), Series V – preliminary exercises (r = 0.692), Series VI – the entire exercise (r = 0.602). The factor can be interpreted as movement control. The factor characterizes training tasks that are directly related to the cartwheel technique.

The analysis of similarities revealed that the program components are interrelated (Table 5). Series of training tasks I, III and IV are combined into one group and provide conditions for teaching girls aged 15 the cartwheel (Fig. 2).

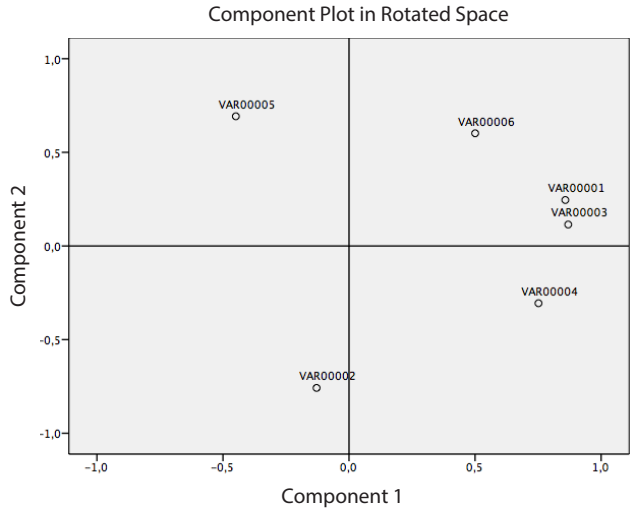

Fig. 2. Results of factor analysis of the teaching program (12 repetitions, rest interval of 60 s)

The analysis of implementation of the teaching program under the conditions of two exercise modes using the nearest neighbor analysis showed that the tasks of series 1, 2 and 3 (Table 7, Fig. 3), and the tasks of series 3, 4 and 5 are most connected with one another (Table 8, Fig. 4).

Table 7. Analysis results

Case Processing Summary		N	Percent
Sample	Training	15	83.3%
	Holdout	3	16.7%
Valid		18	100.0%
Excluded		2	
Total		20	

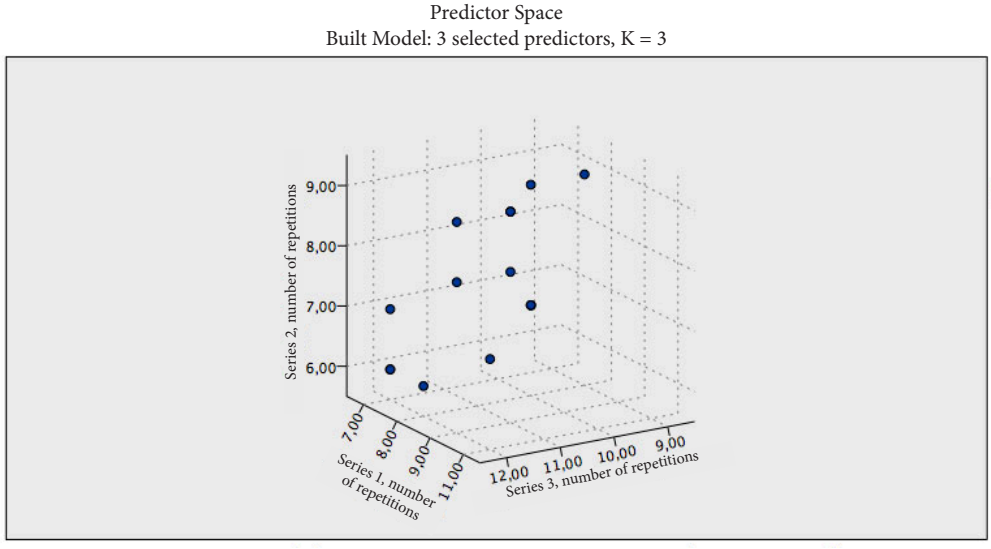

Fig. 3. Analysis results. Nearest neighbor analysis

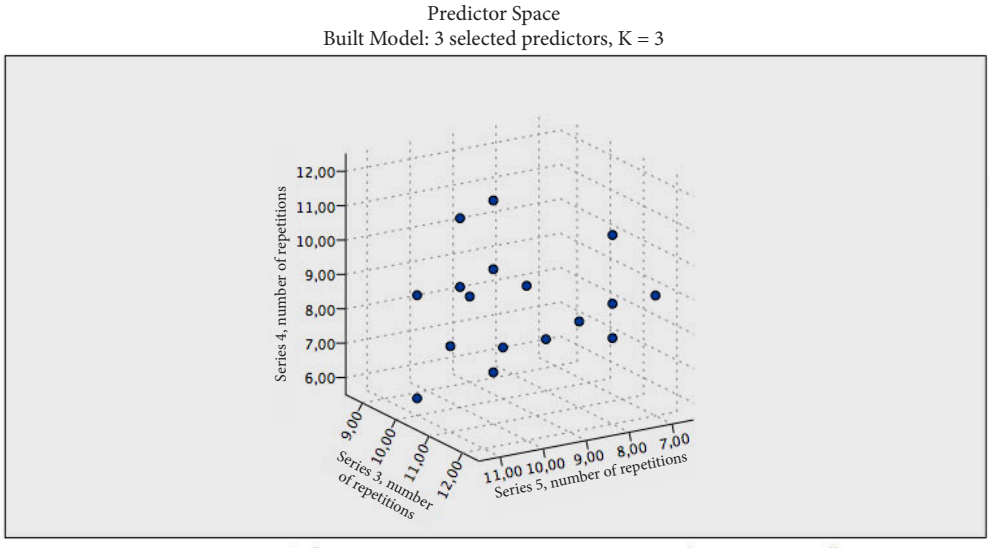

Fig. 4. Analysis results. Nearest neighbor analysis

Table 8. Analysis results. Nearest neighbor analysis

Case Processing Summary		N	Percent
Sample	Training	17	85.0%
	Holdout	3	15.0%
Valid			100.0%
Excluded			
Total			

Discussion

As a result of the pedagogical experiment, the peculiarities of using the method of algorithmic instructions when teaching girls aged 15 the cartwheel were determined. The study obtained factor models of the teaching program, which explain 70.645% and 68.468% of the variation of results. The models characterize the two-factor structure of the teaching program where training tasks are closely connected with one another, which indicates their effective selection. It was found that the tasks of series 1, 2 and 3, and the tasks of series 3, 4 and 5 are most connected with one another, which points to the combined nature of the method of algorithmic instructions. Optimization of the number of repetitions of the entire exercise (series of tasks VI) depends on the amount of exercises of the second and fifth series of training tasks.

The obtained data supplement the results of the study on the patterns of motor skills development (Ivashchenko, 2016, 2020; Khudolii, Iermakov, & Bartik, 2020) and indicate the effectiveness of using the method of algorithmic instructions when teaching physical exercises (Marchenko, & Taranenko, 2020; Marchenko, Jagiello, Iermakov, Ivashchenko, & Khudolii, 2021; Slotte, Sääkslahti, Kukkonen-Harjula, & Rintala, 2017). The study confirmed the combined nature of the method of algorithmic instructions (Shlemin, 1973; Khudolii, 2008; Ivashchenko, 2016).

The obtained data confirm that the method of algorithmic instructions is based on the teaching methods and techniques that exist in physical education and at the same time complements and extends them. In the exercises of the first series of training tasks related to special physical fitness, the method of combination is used; in the second series – the method of separated training and the technique of fixing separate positions; in the third – the method of solving separate motor tasks; in the fourth – the method of immediate and current information about the accuracy of the movements performed; in the fifth – the method of preliminary exercises and separation; in the sixth – the method of holistic training (Shlemin, 1973; Khudolii, 2008).

Since the decision to proceed to the next series is made depending on the level of motor fitness (series of training tasks I), the programming of motor abilities development is a necessary element of the teaching program (Khudolii, Ivashchenko, & Titarenko, 2013; Khudolii, Iermakov, Ivashchenko, & Nosko, 2020; Iermakov, Ivashchenko, Khudolii, & Chernenko, 2020).

Thus, the use of the method of algorithmic instructions can be seen as a technological process with a guaranteed result, which is a step towards improving the effectiveness of school physical education (Samsudin, Setiawan, Taufik, & Solahuddin, 2021; Khudolii, Kapkan, Harkusha, Marchenko, & Veremeenko, 2020; Tkachenko, 2020; Tomaczkowski & Klonowska, 2020).

The study found that factor analysis and nearest neighbor analysis can be used to substantiate the teaching program, which allows determining the relationship of each factor with the result of teaching series of training tasks and the structure of the program.

Conclusions

As a result of the pedagogical experiment, the peculiarities of using the method of algorithmic instructions when teaching girls aged 15 the cartwheel were determined.

The study obtained factor models of the teaching program which explain 70.645% and 68.468% of the variation of results. The models characterize the two-factor structure of the teaching program where training tasks are closely connected with one another, which indicates their effective selection. It was found that the tasks of series 1, 2 and 3, and the tasks of series 3, 4 and 5 are most connected with one another, which confirms the combined nature of the method of algorithmic instructions. Optimization of the number of repetitions of the entire exercise (series of tasks VI) depends on the amount of exercises of the second and fifth series of training tasks.

Acknowledgment

The study was carried out according to the research plan of the Department of Theory and Methodology of Physical Education of H. S. Skovoroda Kharkiv National Pedagogical University within the topic "Theoretical and methodological foundations of modeling the learning process and motor abilities development in children and adolescents" (2013-2022) (state registration number 0112U002008).

Conflict of interest

The authors declare that there is no conflict of interest.

References

Ivashchenko, O. (2020). Research Program: Modeling of Motor Abilities Development and Teaching of Schoolchildren. *Teorìâ ta Metodika Fìzičnogo Vihovannâ, 20*(1), 32-41. https://doi.org/10.17309/tmfv.2020.1.05

Khudolii, O., Iermakov, S., & Bartik, P. (2020). Didactics: Methodological Basis of Motor Learning in Children and Adolescents. *Journal of Learning Theory and Methodology, 1*(1), 5-13. https://doi.org/10.17309/jltm.2020.1.01

Marchenko, S., & Kovalenko, K. (2020). Optimization of Teaching Boys Aged 10 Mae-Geri (Front Kick) Technique in Kyokushin Karate. *Journal of Learning Theory and Methodology, 1*(1), 33-39. https://doi.org/10.17309/jltm.2020.1.05

Gaverdovskii, Iu.K. (2007). *Obuchenie sportivnym uprazhneniiam. Biomekhanika. Metodologiia. Didaktika.* M.: Fizkultura i sport, 912.

Ivashchenko, V. P. (2004). Osnovy teorii ta metodyky prohramovanoho navchannia rukhovym diiam. *Teorìâ ta Metodika Fìzičnogo Vihovannâ,* (3), 29-33.

Yanchenko, T. V. (2016). Prohramovane navchannia yak rezultat evoliutsii idei pedolohii ta bikheviorizmu. *Molodyi vchenyi, 12*(39), 550-554.

Shlemin, A.M. (1973). *Iunyi gimnast.* M.: Fizkultura i sport, 376.

Khudolii, O.M. (2008). *Osnovy metodyky vykladannia himnastyky: Navch. posibnyk.* U 2-kh tomakh. 4-e vyd., vypr. i dop. Kharkiv: "OVS", T. 1, 408.

Ivashchenko, O. V. (2016). *Modelling of physical education students.* Kharkiv, "OVS", 360 p.

Iermakov, S., Ivashchenko, O., Khudolii, O., Chernenko, S., Veremeenko, V., & Zelenskyi, B. (2021). Pattern Recognition: Impact of Exercises Modes on Developing a Small Ball Throwing Skill in Boys Aged 8. *Teorìâ ta Metodika Fìzičnogo Vihovannâ, 21*(1), 77-83. https://doi.org/10.17309/tmfv.2021.1.10

Fishman, E. J., Keller, L., & Atkinson, R. C. (1968). Massed versus distributed practice in computerized spelling drills. *Journal of Educational Psychology, 59*(4), 290-296. Scopus. https://doi.org/10.1037/h0020055

Skinner, B. F. (1965). The technology of teaching. Proceedings of the Royal Society of London. Series B, Containing papers of a Biological character. *Royal Society (Great Britain), 162*(989), 427-443. Scopus. https://doi.org/10.1098/rspb.1965.0048

Skinner, B. F. (1984a). Selection by consequences. *Behavioral and Brain Sciences, 7*(4), 477-481. Scopus. https://doi.org/10.1017/S0140525X0002673X

Skinner, B. F. (1984b). Some consequences of selection. *Behavioral and Brain Sciences, 7*(4), 502-510. Scopus. https://doi.org/10.1017/S0140525X00026984

Berg, A. I., & Tikhonov, I. I. (1968). *Problemy programmirovannogo obucheniia.* L.: Znanie, 3-22.

Golubev, V. P. (1969). Programmirovannoe obuchenie v teorii i praktike fizicheskogo vospitaniia studentov. *Teoriia i praktika fizicheskoi kultury,* 6, 50-52.

Malinovskii, S. V. (1972). Primenenie sistem programmirovannogo obucheniia v sporte. *Teoriia i praktika fizicheskoi kultury,* 3, 48-52.

Laputin, A. N. (1986). *Obuchenie sportivnym dvizheniiam.* K.: Zdorovia, 216.

Khudolii, O., Ivashchenko, O., & Titarenko, A. (2013). Osoblyvosti prohramuvannia rozvytku syly u khlopchykiv molodshykh klasiv. *Teorìâ ta Metodika Fìzičnogo Vihovannâ,* (3), 3-12. https://doi.org/10.17309/tmfv.2013.3.1020

Khudolii, O., Iermakov, S., Ivashchenko, O., & Nosko, M. (2020). Strength Abilities: Modeling of Immediate and Delayed Training Effect of Strength Loads in Boys Aged 8 Years. *Teorìâ ta Metodika Fìzičnogo Vihovannâ, 20*(4), 248-255. https://doi.org/10.17309/tmfv.2020.4.08

Iermakov, S., Ivashchenko, O., Khudolii, O., & Chernenko, S. (2020). Strength Abilities: Assessment of Training Effects of Strength Loads in Boys Aged 8 Years. *Teorìâ ta Metodika Fìzičnogo Vihovannâ, 20*(3), 174-181. https://doi.org/10.17309/tmfv.2020.3.07

Marchenko, S., & Taranenko, O. (2020). Managing the Effectiveness of Teaching Boys Aged 10 Mawashi-Geri (Roundhouse Kick) Technique in Kyokushin Karate. *Teorìâ ta Metodika Fìzičnogo Vihovannâ, 20*(4), 262-268. https://doi.org/10.17309/tmfv.2020.4.10

Marchenko, S., Jagiello, W., Iermakov, S., Ivashchenko, O., & Khudolii, O. (2021). Pattern recognition: modes of teaching boys aged 10 mae-geri (front kick) technique in kyokushin karate. *Archives of Budo,* 17, 253-261. https://archbudo.com/view/abstract/id/14538

Slotte, S., Sääkslahti, A., Kukkonen-Harjula, K., & Rintala, P. (2017). Fundamental movement skills and weight status in children: A systematic review. *Baltic Journal of Health and Physical Activity, 9*(2), 115-127. https://doi.org/10.29359/BJHPA.09.2.11

Samsudin, S., Setiawan, I., Taufik, M., & Solahuddin, S. (2021). Volleyball Fundamental Movement Learning Model in Primary School. *Teorìâ ta Metodika Fìzičnogo Vihovannâ, 21*(3), 194-199. https://doi.org/10.17309/tmfv.2021.3.02

Khudolii, O., Kapkan, O., Harkusha, S., Marchenko, S., & Veremeenko, V. (2020). Motor Skills Development: Optimization of Teaching Boys Aged 15 Press Headstand and Handstand. *Teorìâ ta Metodika Fìzičnogo Vihovannâ, 20*(1), 42-48. https://doi.org/10.17309/tmfv.2020.1.06

Tkachenko, M. (2020). Peculiarities of Motor Fitness Dynamics of 5th-6th Grade Students During a School Year. *Teorìâ ta Metodika Fìzičnogo Vihovannâ, 20*(1), 49-55. https://doi.org/10.17309/tmfv.2020.1.07

Tomaczkowski, L., & Klonowska, J. (2020). Physical activity of school children and youth. *Balt J Health Phys Activ, 12*(2), 83-87. https://doi.org/10.29359/BJHPA.12.2.09

ФОРМУВАННЯ РУХОВИХ НАВИЧОК: ОСОБЛИВОСТІ ПРОГРАМОВАНОГО НАВЧАННЯ АКРОБАТИЧНИХ ВПРАВ ДІВЧАТ 15 РОКІВ

Аліна Шуєва[1ABCDE], Ольга Іващенко[1ABCDE], Владіслав Ягелло[2ACDE]

[1]Харківський національний педагогічний університет імені Г. С. Сковороди
[2]Гданський університет фізичного виховання і спорту

Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 7 с., 8 табл., 4 рис., 27 джерел.

Мета дослідження – визначити особливості програмованого навчання перевороту убік дівчат 15 років.

Матеріали і методи. У дослідженні прийняли участь 20 дівчат 15 років. Діти та їхні батьки були інформовані про всі особливості дослідження і дали згоду на участь в експерименті. Для вирішення поставлених завдань були використані методи дослідження: вивчення та аналіз науково-методичної літератури; педагогічне спостереження, хронометраж навчальних завдань; педагогічний експеримент, методи математичної статистики, факторний аналіз, метод найближчих сусідів.

Результати. Аналіз спільностей дозволив встановити, що компоненти програми взаємозв'язані. Найбільшу кореляцію мають IV, V та VI серії навчальних завдань. I, III та IV серії навчальних завдань об'єднуються в одну плеяду і забезпечують умови для навчання перевороту убік дівчат 15 років.

Висновки. У дослідженні отримано факторні моделі програми навчання які на 70,645% та 68,468% пояснюють варіацію результатів. Моделі характеризують двох факторну структуру програми навчання у якій кожне навчальне завдання має тісний зв'язок між собою, що свідчить про їх ефективний підбір. Встановлено що найбільш зв'язані між собою є завдання I, II та III серії і завдання III, IV та V серії, що підтверджує комбінований характер методу алгоритмічних розпоряджень. Оптимізація кількості повторень вправи в цілому (VI серія завдань) залежить від обсягу виконання вправ другої і п'ятої серії навчальних завдань.

Ключові слова: програмоване навчання, метод алгоритмічних розпоряджень, акробатичні вправи, дівчата.

Information about the authors:

Shueva Alina: alinkashueva@gmail.com; https://orcid.org/0000-0002-2743-2511; H. S. Skovoroda Kharkiv National Pedagogical University, Department of Theory and Methodology of Physical Education, Alchevskykh St, 29, Kharkiv, 61002, Ukraine

Ivashchenko Olha: ivashchenko@hnpu.edu.ua; https://orcid.org/0000-0002-2708-5636; H. S. Skovoroda Kharkiv National Pedagogical University, Department of Theory and Methodology of Physical Education, Alchevskykh St, 29, Kharkiv, 61002, Ukraine

Jagiello Wladyslaw: wjagiello1@wp.pl; https://orcid.org/0000-0001-7417-4749; Gdansk University of Physical Education and Sport, Kasimir Gorskogo St, 1, 80-336 Gdansk, Poland.

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