



ORIGINAL SCIENTIFIC ARTICLE

PATTERN RECOGNITION: THE SPECIFIC FEATURES OF TEACHING THE STANDING LONG JUMP TO 14-YEAR-OLD GIRLS

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

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Accepted for Publication: December 17, 2022

Published: December 23, 2022

DOI: 10.17309/tmf.v.2022.4.19

Abstract

The study purpose was to determine the specific features of the effect of the number of repetitions and rest intervals on the effectiveness of the standing long jump training program for 14-year-old girls.

Materials and methods. The study participants were 40 girls aged 14. The study participants were informed about all the features of the experiment and gave their consent to participate therein. The study used methods of analysis of scientific and methodological literature, observation, pedagogical experiment, and methods of mathematical statistics. The pedagogical experiment was designed as a full factorial experiment with a 2x factorial design. The effect of the number of repetitions (6 to 12 times) and the rest interval (60 to 120 s) on the effectiveness of the standing long jump training program for 14-year-old girls was investigated. Discriminant analysis was used for data analysis.

Results. The analysis of the experimental data showed that the modes of alternating physical exercise performance and rest intervals have a statistically significant effect on the formation of the motor skill of standing long jump in 14-year-old girls ($p < 0.001$). It is after the third exercise performance mode that the girls spent the smallest total number of repetitions required for the formation of the standing long jump skill. Thus, the 1st, 4th and 6th series of training tasks are learned faster after the third exercise performance mode, the 3rd series of training tasks is learned faster after the second exercise performance mode, and the 2nd and 5th series of training tasks are learned faster after the fourth exercise performance mode ($p < 0.001$).

Conclusions. It was established that the mode of alternating exercises in 3 sets of 2 repetitions with a rest interval of 120 s is classified as the most rational. A specific feature of the formation of the motor skill is that each of the modes can be considered as a priority for one or another motor task. In the investigation of the learning process, discriminant analysis makes it possible to classify work modes and determine the relationship between the motor tasks within the training program.

Keywords: 14-year-old girls, standing long jump, exercise performance modes, discriminant analysis.

Introduction

Forming motor skills (Ivashchenko, Berezhna, & Cieřlicka, 2020; Khudolii, Iermakov, & Bartik, 2020; Petrov, Khudolii, & Cieřlicka, 2020), developing motor abilities (Khudolii, Ivashchenko, Iermakov, Veremeenko, & Lopatiev, 2019; Marchenko & Bezpalko, 2020; Ivashchenko, Mirosława, Nosko, & Malyshev, 2019), and increasing motor activity (Fisher, Reilly, Kelly, Montgomery, Williamson, Patton, & Grant, 2005; Fernández-Valero, Soto-Sánchez, Pérez, Leyton-Dinamarca, Kain, Hurtado, & Reyes-Amigo, 2021; Nurulfa, Lubis, Dis, Aninggar, & Mamesah, 2021) are the

main tasks of school physical education and have a positive effect on the health of school students (Vandoni, Codella, Pippi, Pellino, Lovecchio, Marin, Silvestri, Gatti, Magenes, Regalbuto, Fabiano, Zuccotti, & Calcaterra, 2021; Villafaina, Fuentes-García, Leon-Llamas, & Collado-Mateo, 2021; Vlasova, 2020).

Selection of motor tasks (Thomaidou, Konstantinidou, & Venetsanou, 2021; Suprun, Ivashchenko, & Cieřlicka, 2021; Khakovshchenko, 2022), organization of training programs that ensure a guaranteed level of mastery of physical exercises, and control of the quality of training (de Mooij, Fekkes, Scholte, & Overbeek, 2020; Ivashchenko, 2020; Schneeberger, & Jarosch, 2022), and modes of alternating exercise performance and rest intervals (Marchenko, Jagiello, Iermakov, Ivashchenko, & Khudolii, 2021; Marchenko,

Ivashchenko, Jagiello, Iermakov, Khudolii, & Yermakova, 2022; Shuieva, Ivashchenko, & Jagiello, 2021) are of importance in teaching physical exercises.

In the structure of programs such as algorithmic instructions, it is mandatory to determine the necessary level of motor fitness, which includes motor experience and the level of development of motor abilities (Khudolii, 2009). The achievement of the appropriate level of development of motor abilities is influenced by the accounting and control of the operational, delayed (Khudolii, Ivashchenko, Iermakov, Nosko, & Marchenko, 2019; Ivashchenko, Khudolii, Prusik, & Giovanis, 2020; Khudolii, Iermakov, Ivashchenko, & Nosko, 2020), and cumulative training effect of strength exercises (Veremeenko, 2019; Iermakov, Ivashchenko, & Khudolii, 2021). Optimizing the time allocated to teaching and developing motor abilities is important for increasing the effectiveness of the learning process in a physical education class (Ivashchenko, Iermakov, & Khudolii, 2021).

To substantiate the training program, methods of mathematical statistics are used, such as correlation, factor and discriminant analysis (Ivashchenko, 2020). Since the quality of the implementation of the programs depends on the modes of alternating exercise performance and rest intervals (Shuieva, Ivashchenko, & Jagiello, 2021; Yunak, Ivashchenko, Nosko, & Nosko, 2022; Marchenko, Ivashchenko, Jagiello, Iermakov, Khudolii, & Yermakova, 2022), the choice of discriminant analysis will make it possible to classify work modes and determine the relationship between the motor tasks within the training program (Silverman, Woods, & Subramaniam, 1998; Vandorpe, Vandendriessche, Vaeyens, Pion, Lefevre, Philippaerts, & Lenoir, 2011; Rebelo-Gonçalves, Coelho-e-Silva, Severino, Tessitore, & Figueiredo, 2015).

The study purpose was to determine the specific features of the effect of the number of repetitions and rest intervals on the effectiveness of the standing long jump training program for 14-year-old girls.

Materials and methods

Study Participants

The study participants were 40 girls aged 14. The study participants were informed about all the features of the experiment and gave their consent to participate therein.

Study Organization

The study used methods of analysis of scientific and methodological literature, observation, pedagogical experiment, and methods of mathematical statistics.

The pedagogical experiment was designed as a full factorial experiment with a 2^k factorial design. The effect of the number of repetitions (6 to 12 times) and the rest interval (60 to 120 s) on the effectiveness of the standing long jump training program for 14-year-old girls was investigated (Table 1). The study recorded the number of repetitions necessary for the correct performance of the task in three consecutive repetitions.

Standing long jump technique. Before jumping, the school student places his feet parallel at a distance of 10–15 cm, performs a rhythmic half-squat with the body leaning

Table 1. Design of the full factorial experiment with a 2^k factorial design

Experimental groups	N	Number of repetitions, times	Rest interval, s
1	10	6 (3 sets of 2 repetitions)	60
2	10	12 (6 sets of 2 repetitions)	60
3	10	6 (3 sets of 2 repetitions)	120
4	10	12 (6 sets of 2 repetitions)	120

forward, with arm movements back and forth, without separating the heels from the ground. Significantly leaning the body forward and losing balance, sharply extends the legs and body, makes a wave of the arms forward and upward so that by the end of the take-off, the legs, body and arms form one straight line at an angle of 45° . The main feature of the standing long jump technique (besides the lack of running) is that the take-off is performed simultaneously with both legs.

In flight, the school student needs to relax his muscles and maintain a short pause in free flight, before the end of which the school student's body assumes an arched position. In the second half of the flight, the school student prepares for landing: he quickly lowers his arms forward-down-back, pulls his knees to his chest and, extending his legs at the knee joints, 'throws' his lower legs forward. The end of leg extension in the knee joints should coincide with the moment of landing.

Landing, complement the movements by bringing the pelvis forward, strongly arching in the lumbar part of the spine (by bringing the pelvis forward) and rolling over the toes, it is important not to lose balance and not to fall back. To this end, the legs are extremely bent at the knee joints, and the arms are actively extended forward.

Standing long jump exercise training program. The program of algorithmic instructions was organized taking into account the data of Hohin and Hohina (2006, 2008), Khudolii (2009) and included six series of training tasks (Table 2).

Statistical Analysis

The experimental data were processed using the SPSS 20 statistical analysis application software. Discriminant analysis was carried out.

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 a signed informed consent document was obtained from all parents.

Results

The experimental data analysis showed that the modes of alternating physical exercises and rest intervals have a statistically significant effect on the formation of the motor skill of standing long jump in 14-year-old girls ($p < 0.001$). It is after the third exercise performance mode that the girls spent the smallest total number of repetitions required for the formation of the standing long jump skill. Thus, the 1st, 4th and 6th series of training tasks are learned faster after the third exercise performance mode, the 3rd series of training

Table 2. Standing long jump exercise training program

Information frame (what we perform)	Operational frame (how we perform)	Control frame (proceed to learn the next exercise)
First series of training tasks:		
30 s rope jumping.	a) on two legs with forward rotation; 6) on two legs with backward rotation.	If the school student performs 40 to 50 jumps, then proceed to the next exercise.
Jumps with straight legs pulled up.	Taking off with two legs, in place.	If the school student performs 10 to 15 jumps, then proceed to the next exercise.
Multiple forward jumps.	On two legs, 8 to 12 jumps.	If the school student performs 3 series, then proceed to the next exercise.
Second series of training tasks:		
Performing imitative movements with arms, in place.	Half-squats with the torso bends forward, arm movements back and forth, without separating the heels from the surface.	If the school student performs 3-4 series of 2-3 rhythmical movements, then proceed to the next exercise.
Take the correct landing position and fix it for 5 s.	Squat on the whole foot, feet parallel at a distance of 10–15 cm, hands forward outward, head straight.	If the school student performs 4 to 6 times, then proceed to the next exercise.
Vertical jump in place.	Landing in a squat on the toes with a transition to the whole foot.	If the school student performs 10 to 12 times, then proceed to the next exercise.
Third series of training tasks:		
Jumps on two legs with the knees pulled up to the chest.	Taking off with two legs, in place.	If the school student performs 10 to 12 times, then proceed to the next exercise.
From a lying support, push the arms and legs to squat, arms forward.	When performing this exercise, the school student needs to ensure that after pushing with his hands and legs, there is an airborne phase, the flight phase.	If the school student performs 10 to 12 times, then proceed to the next exercise.
Bringing the pelvis forward.	By strongly arching in the lumbar part of the spine.	Be able to perform in a series of 5 attempts.
Multiple jumps forward-up from a squat.	2-3 series of 10–15 times.	If the school student performs, then proceed to the next exercise.
Fourth series of training tasks:		
Multiple jumps up and forward in jumps from foot to foot.	2 series of 10–15 times.	If the school student performs, then proceed to the next exercise.
Squats on one leg.	10 to 12 squats on each leg.	If the school student performs 2-3 series, then proceed to the next exercise.
Jumping out of a squat on one leg.	Repeat 3-4 times on each leg.	If the school student performs 2-3 series, then proceed to the next exercise.
Fifth series of training tasks:		
Jumps on two legs over obstacles 50 cm high.	Perform with a stronger push of the legs.	If the school student performs 3–5 series of 4–6 times, then proceed to the next exercise.
Jumps on two legs with forward movement.	Complicating the exercise by touching landmarks with hands.	If the school student performs 4–6 series of 4–6 times, then proceed to the next exercise.
Standing jump with double take-off onto an elevated support.	Pay attention to take-off.	If the school student performs 2 series of 10 times, then proceed to the next exercise.
Sixth series of training tasks:		
Standing long jump preceded by 2-3 rhythmic squats with the torso bends forward.	Perform the exercise as quickly as possible, keeping to the technique.	Be able to perform in a series of 3–5 attempts.
Standing long jump with back-and-forth arm movements without leaving the heels off the ground.	Perform the exercise as quickly as possible, keeping to the technique.	Be able to perform in a series of 3 attempts.
Standing long jump.	Perform the exercise in accordance with the technique described above.	The correct performance of a series of 3–5 attempts.

tasks is learned faster after the second exercise performance mode, and the 2nd and 5th series of training tasks are learned faster after the fourth exercise performance mode ($p < 0.001$) (Table 3).

The conducted discriminant analysis indicates the statistical significance of the obtained discriminant functions (Tables 4, 5). The first and second discriminant functions explain

93.9% of the variation in the results and have high canonical correlation values. Testing of the functions indicates their reliability in the classification of the modes of exercise performance and rest intervals based on the results of formation of the motor skill of standing long jump in 14-year-old girls.

The standardized coefficients of the discriminant functions made it possible to establish the weight of motor tasks

Table 3. Group Statistics. Tests of Equality of Group Means

Training tasks	Exercise performance modes								F	p
	1		2		3		4			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
1 st series of training tasks	4.6	0.69921	6.2	0.42164	3.3	0.67495	4.0	0.66667	39.043	0.000
2 nd series of training tasks	11.2	1.81353	11.5	1.35401	9.7	1.33749	7.9	1.52388	11.794	0.000
3 rd series of training tasks	7.2	1.03280	5.9	0.99443	11.6	1.26491	8.0	0.94281	52.482	0.000
4 th series of training tasks	9.8	1.22927	9.4	1.42984	6.0	0.81650	11.8	1.31656	38.933	0.000
5 th series of training tasks	10.5	1.58114	12.7	1.49443	13.2	1.54919	9.7	1.33749	12.803	0.000
6 th series of training tasks	6.8	2.61619	10.5	3.56682	5.6	2.98887	12.0	3.16228	9.471	0.000
Total repetitions	50.1	1.49535	56.2	1.54352	49.4	1.43865	53.4	1.49161		

Table 4. Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	10.497	67.1	67.1	0.956
2	4.192	26.8	93.9	0.899
3	0.955	6.1	100.0	0.699

Table 5. Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 3	0.009	161.830	18	0.000
2 through 3	0.099	78.798	10	0.000
3	0.512	22.794	4	0.000

Table 6. Standardized Canonical Discriminant Function Coefficients

Series of training tasks	Function		
	1	2	3
1 st series of training tasks	0.511	0.501	0.407
2 nd series of training tasks	0.315	0.165	-0.843
3 rd series of training tasks	-0.844	-0.185	0.164
4 th series of training tasks	0.284	-0.853	-0.146
5 th series of training tasks	-0.304	0.491	0.440
6 th series of training tasks	0.099	0.047	0.722

under different exercise performance modes. Thus, in the analysis of the four exercise performance modes, the third and first series of training tasks have the greatest weight (first function); in the analysis of 2-4 exercise performance modes, the fourth series of training tasks has the greatest weight (second function); and in the analysis of 3-4 exercise performance modes, the second and sixth series of training tasks have the greatest weight (third function) (Table 6).

The structure coefficients of the discriminant functions indicate a correlation between the motor tasks and the function values. Thus, the third and first series of training tasks have the highest correlation with the first function; the fourth and fifth series of training tasks have the highest correlation with the second function; and the second and sixth series of training tasks have the highest correlation with the third function (Table 7).

Table 7. Structure Matrix

Series of training tasks	Function		
	1	2	3
3 rd series of training tasks	-0.645	-0.008	0.033
1 st series of training tasks	0.490	0.401	0.245
4 th series of training tasks	0.397	-0.608	0.210
5 th series of training tasks	-0.114	0.458	0.227
6 th series of training tasks	0.170	-0.185	0.598
2 nd series of training tasks	0.129	0.379	-0.466

Table 8. Functions at Group Centroids

Exercise performance modes	Function		
	1	2	3
1	1.342	-.399	-1.542
2	3.317	2.198	0.691
3	-4.988	1.160	0.094
4	0.328	-2.959	0.758

The Functions at Group Centroids analysis shows that the third and second modes of exercise performance are diametrically distinguished by the total effect on the formation of the motor skill of standing long jump. The third mode of exercise performance has the greatest total effectiveness in the formation of the motor skill (Table 8).

Discussion

The study found out the specific features of the formation of the motor skill of standing long jump in 14-year-old girls depending on the modes of alternating exercise performance and rest intervals. It was established that the mode of alternating exercises in 3 sets of 2 repetitions with a rest interval of 120 s is classified as the most rational. The obtained data complement the results of the study on the influence of work modes on the formation of motor skills (Marchenko et al, 2021, 2022; Shuieva et al., 2021).

A specific feature of the formation of the motor skill is that each of the modes can be considered as a priority for one or another motor task. On the one hand, in the process of the motor skill formation, a physical education teacher can change over from one mode to another; on the other hand,

choosing the best mode based on the total score improves the controllability of the learning process. So, the proposed exercise performance modes characterize the integrity of the learning process and contribute to increasing the motor activity of girls. The data complement the results of the study on the organization of the learning process having an effect on the increase in motor activity of school students (Fisher et al., 2005; Fernández-Valero et al., 2021; Nurulfa et al, 2021).

The analysis of the standardized and structure discriminant function coefficients made it possible to identify the training tasks that have the greatest weight and the highest correlation with the results of the discriminant functions. The obtained data give grounds for asserting that the training tasks are interconnected and characterize an integral standing long jump training program for 14-year-old girls. The data complement the results of the study on the importance of selecting motor tasks and organizing training programs (Thomaidou et al., 2021; Suprun et al., 2021; Khar-kovshchenko, 2022) and the results of the study on discriminant analysis making it possible to classify work modes and

determine the relationship between the motor tasks within the training program (Silverman et al., 1998; Vandorpe et al., 2011; Rebelo-Gonçalves et al., 2015).

The effectiveness of using discriminant analysis is confirmed by the fact that 95% of the data were classified correctly (Table 9). A graphical display of the results of the classification of the modes of performance of training tasks in the process of teaching the standing long jump to 14-year-old girls makes it possible to choose the best option (Fig. 1).

Conclusions

It was established that the mode of alternating exercises in 3 sets of 2 repetitions with a rest interval of 120 s is classified as the most rational. A specific feature of the formation of the motor skill is that each of the modes can be considered as a priority for one or another motor task.

In the investigation of the learning process, discriminant analysis makes it possible to classify work modes and determine the relationship between the motor tasks within the training program.

Table 9. Classification Results^a

	Exercise performance modes	Predicted Group Membership				Total
		1	2	3	4	
Original	Count					
	1	8	0	0	2	10
	2	0	10	0	0	10
	3	0	0	10	0	10
%	4	0	0	0	10	10
	1	80.0	.0	.0	20.0	100.0
	2	.0	100.0	.0	.0	100.0
	3	.0	.0	100.0	.0	100.0
	4	.0	.0	.0	100.0	100.0

a. 95.0% of original grouped cases correctly classified.

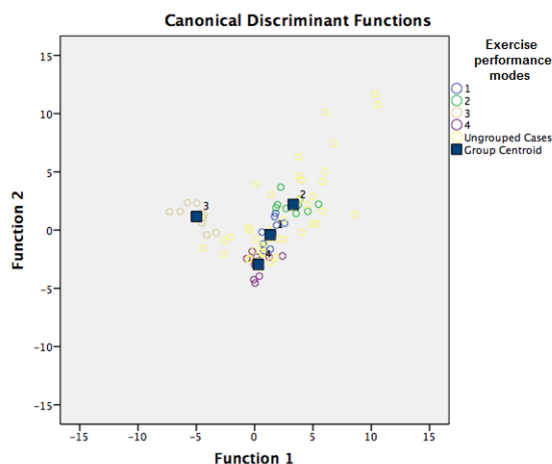


Fig. 1. Canonical discriminant functions. A graphical display of the results of the classification of the modes of performance of training tasks in teaching the standing long jump to 14-year-old girls: ■ – centroids for training task performance modes 1, 2, 3, 4.

Conflict of Interest

The authors declare no conflict of interest.

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РОЗПІЗНАННЯ ОБРАЗІВ: ОСОБЛИВОСТІ ПРОЦЕСУ НАВЧАННЯ СТРИБКУ У ДОВЖИНУ З МІСЦЯ ДІВЧАТ 14 РОКІВ

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Авторський вклад: А – дизайн дослідження; В – збір даних; С – статаналіз; D – підготовка рукопису; Е – збір коштів

Реферат. Стаття: 7 с., 9 табл., 1 рис., 34 джерела.

Мета дослідження – визначити особливості впливу кількості повторень та інтервалів відпочинку на ефективність програми навчання стрибку у довжину з місця дівчат 14 років.

Матеріали і методи. У дослідженні прийняли участь 40 дівчат 14 років. Учасники дослідження були ознайомлені з особливостями проведення експерименту і надали згоду на участь в ньому. У дослідженні використані методи аналізу науково-методичної літератури, спостереження, педагогічний експеримент, методи математичної статистики. Педагогічний експеримент був організований за планом ПФЕ типу 2*. Вивчався вплив кількості повторень (6-12 раз) та інтервалу відпочинку (60-120 с) на ефективність програми навчання стрибку у довжину з місця дівчат 14 років. Для аналізу даних був використаний дискримінантний аналіз.

Результати. Аналіз експериментальних даних показав, що режими чергування виконання фізичних вправ та інтервалів відпочинку статистично достовірно впливають на формування рухової навички стрибку у довжину з місця дівчат 14 років ($p < 0.001$). Найменшу сумарну кількість повторень на формування навички стрибку у довжину з місця дівчата витратили після третього режиму виконання вправ. Так, 1, 4 та 6 серії навчальних завдань швидше засвоюються після третього режиму виконання вправ, 3 серія навчальних завдань – після другого режиму виконання вправ, 2 та 5 серії навчальних завдань – після четвертого режиму виконання вправ ($p < 0,001$).

Висновки. Встановлено, що режим чергування вправ 3 підходить по 2 рази з інтервалом відпочинку 120 с класифікується як найбільш раціональний. Особливістю формування рухової навички є те, що кожен з режимів може розглядатися як пріоритетний для того чи іншого рухового завдання. У дослідженні процесу навчання дискримінантний аналіз надає можливість здійснити класифікацію режимів роботи і визначити взаємозв'язок рухових завдань програми навчання.

Ключові слова: дівчата 14 років, стрибок у довжину з місця, режими виконання вправ, дискримінантний аналіз.

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Cite this article as: Zima, D., Ivashchenko, O. (2022). Pattern Recognition: The Specific Features of Teaching the Standing Long Jump to 14-Year-Old Girls. *Physical Education Theory and Methodology*, 22(4), 589-595. <https://doi.org/10.17309/tmfv.2022.4.19>

Received: 10.11.2022. Accepted: 16.12.2022. Published: 23.12.2022

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