



ORIGINAL SCIENTIFIC ARTICLE

PATTERN RECOGNITION: AGE-SPECIFIC FEATURES OF FUNDAMENTAL MOVEMENT SKILLS FORMATION IN ELEMENTARY SCHOOL STUDENTS

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Abstract

The purpose of the study was to determine the age-specific features of fundamental movement skills formation in elementary school students.

Materials and methods. The study participants were boys aged 7 to 10 (24 boys aged 7; 28 boys aged 8; 35 boys aged 9; 36 boys aged 10). The children and their parents or legal guardians were fully informed about all the special aspects of the study and all the parents or legal guardians gave their consent thereto. The study protocol was approved by the Ethics Committee of the University.

The features of teaching 7–10-year-old boys to throw a ball at a vertical target were investigated. The proficiency level in throwing exercises in class was assessed using an alternative method ("performed", "failed"), the probability of the exercise performance was calculated ($p = n/m$, where n is the number of successful attempts, m is the total number of attempts). A method of algorithmic instructions was used in teaching boys aged 7 to 10. The study materials were processed by IBM SPSS 20 statistical analysis software. A discriminant analysis was conducted.

Results. It was established that the first canonical function explains 64.5% of the variation in results, while the second one does 34.4%, which indicates their high informativity ($r_1 = 0.762$; $r_2 = 0.652$). The materials of the canonical function analysis show the statistical significance of the first and second canonical functions ($\lambda_1 = 0.236$; $p_1 = 0.001$; $\lambda_2 = 0.5633$; $p_2 = 0.001$). The first and second functions have a high discriminative ability and value in interpretation with respect to the general population.

Conclusions. The discriminant analysis made it possible to determine the age-specific features of throwing skills formation in boys aged 7 to 10; answer the questions to which extent the differences in the effectiveness of skills formation in boys aged 7 to 10 are significant; which motor tasks are the most specific to boys aged 7, 8, 9, 10; which class an object belongs to based on the values of discriminant variables.

It was established that the level of proficiency in exercise 4 "Throwing a ball forward-upward standing with the left side to the throwing direction" has the greatest effect on the process of throwing movement skills formation in boys aged 7 to 10. For boys aged 8 to 10, such an exercise is "Throwing a ball forward-upward standing feet apart", and for boys aged 9 to 10, such an exercise is "Throwing a ball at a target 3 m away".

Keywords: fundamental movement skills, boys, discriminant analysis.

Introduction

The problem of studying the patterns and regularities of the formation of motor skills in schoolchildren is of relevance in view of the need to optimize their motor activity and improve their health (Barnett et al., 2013; Chan et al., 2016; Lubans et al., 2010).

A number of studies are devoted to the development of the definition of "Fundamental Movement Skills" and its introduction into the practice of physical education (Barnett et al., 2009, 2016; Cools et al., 2011). Barnett et al. (2016) defined the concept of FMS, discussed the context of what skills can be considered fundamental, how the development of these skills is related to the context of health development and pedagogical approaches in teaching FMS. According to the authors, FMS are defined as basic learned movement patterns that are artificially created and are the basis for more

complex physical and sports exercises. They can be divided into three individual categories: locomotion (moving the body, such as running), object control (manipulative skills, such as catching a ball), and stability skills, such as balancing. Motor coordination is a major component of FMS.

The studies by Mathisen (2016), Nurulfa et al. (2021), Fernández-Valero et al. (2021) show the importance of developing manual dexterity, body balance and ball exercise performance skills in children. The importance of FMS formation in children and adolescents is supported by the findings of the studies by Akbar et al. (2021), Basman (2019), Iermakov et al. (2021).

The features of manipulative skills formation in children and adolescents were studied by Sulistiyono et al. (2021), Samsudin et al. (2021), Dudley et al. (2011). Gaming activities were established to have a positive effect on the effectiveness of manipulative skills formation (Marchenko & Handymov, 2021; Marchenko & Satdyiev, 2021). Throwing a small ball at a vertical target was considered as one of the elements of fundamental movement skills (Iermakov et al., 2021; Ivashchenko et al., 2018, 2019). The results of the study of the effectiveness of the formation of motor skills with complex motor coordination indicate the need to take into account the exercise performance modes (Ivanov et al., 2021; Kalistratova & Khudolii, 2021; Bezzub et al., 2021) and the content component (Suprun et al., 2021; Shueva et al., 2021).

In order to obtain unbiased results about the patterns and regularities of the learning process, it is important to plan the experiment (Ivashchenko et al., 2018; Pambudi et al., 2021; Septaliza et al., 2022) and use multivariate statistics (Medko & Khudolii, 2021; Marchenko et al., 2021, 2022).

The effectiveness of factorial experiment plans (Ivashchenko et al., 2018; Marchenko & Taranenko, 2020) and discriminant analysis in studying the patterns and regularities of the learning process of children and adolescents was established (Medko & Khudolii, 2021; Marchenko et al., 2021, 2022). Therefore, the use of factorial experiment plans and discriminant analysis will make it possible to obtain new information about the age-specific features of fundamental movement skills formation in elementary school students.

The purpose of the study was to determine the age-specific features of fundamental movement skills formation in elementary school students.

Materials and Methods

Study Participants

The study participants were boys aged 7 to 10 (24 boys aged 7; 28 boys aged 8; 35 boys aged 9; 36 boys aged 10). The children and their parents or legal guardians were fully informed about all the special aspects of the study and all the parents or legal guardians gave their consent thereto. The study protocol was approved by the Ethics Committee of the University.

Study Organization

The study used analysis and generalization of data from scientific and methodological literature, general scientific methods of theoretical level, such as analogy, analysis, synthesis, abstraction, induction as well as general scien-

Table 1. The age-specific features of FMS formation in boys aged 7 to 10. Group Statistic

Ages 7 to 10		Mean	Std. Deviation	Valid N (listwise)	
				Unweighted	Weighted
7	1. Throwing a ball against the floor	0.8875	0.03378	24	24
	2. Throwing a ball forward-upward standing feet apart	0.7958	0.08065	24	24
	3. Throwing a ball forward-upward standing with the left foot forward	0.8333	0.07614	24	24
	4. Throwing a ball forward-upward standing with the left side to the throwing direction	0.8875	0.11910	24	24
	5. Throwing a ball at a target 3 m away	0.7188	0.08184	24	24
8	1. Throwing a ball against the floor	0.8893	0.03150	28	28
	2. Throwing a ball forward-upward standing feet apart	0.7518	0.08331	28	28
	3. Throwing a ball forward-upward standing with the left foot forward	0.8714	0.05345	28	28
	4. Throwing a ball forward-upward standing with the left side to the throwing direction	0.8714	0.04600	28	28
	5. Throwing a ball at a target 3 m away	0.7446	0.09939	28	28
9	1. Throwing a ball against the floor	0.8071	0.08238	35	35
	2. Throwing a ball forward-upward standing feet apart	0.6871	0.11071	35	35
	3. Throwing a ball forward-upward standing with the left foot forward	0.7229	0.11526	35	35
	4. Throwing a ball forward-upward standing with the left side to the throwing direction	0.6686	0.13289	35	35
	5. Throwing a ball at a target 3 m away	0.7514	0.12455	35	35
10	1. Throwing a ball against the floor	0.8806	0.04014	36	36
	2. Throwing a ball forward-upward standing feet apart	0.8583	0.05000	36	36
	3. Throwing a ball forward-upward standing with the left foot forward	0.6972	0.17194	36	36
	4. Throwing a ball forward-upward standing with the left side to the throwing direction	0.7375	0.11108	36	36
	5. Throwing a ball at a target 3 m away	0.7542	0.11236	36	36

Table 2. Tests of Equality of Group Mean. Boys aged 7 to 10

Content	Wilks' Lambda	F	df1	df2	Sig.
1. Throwing a ball against the floor	0.688	17.965	3	119	0.000
2. Throwing a ball forward-upward standing feet apart	0.607	25.711	3	119	0.000
3. Throwing a ball forward-upward standing with the left foot forward	0.722	15.258	3	119	0.000
4. Throwing a ball forward-upward standing with the left side to the throwing direction	0.584	28.308	3	119	0.000
5. Throwing a ball at a target 3 m away	0.985	0.598	3	119	0.618

tific methods of empirical level: observation, testing, and experiment.

When teaching throwing exercises in class, the proficiency level was assessed using an alternative method ("performed", "failed"), the probability of the exercise performance was calculated ($p = n/m$, where n is the number of successful attempts, m is the total number of attempts).

A method of algorithmic instructions was used in teaching boys aged 7 to 10. The participants proceeded to the next exercise after three successful attempts. Throwing a ball at a vertical target was mastered. The following exercises were mastered: 1. Throwing a ball against the floor; 2. Throwing a ball forward-upward standing feet apart; 3. Throwing a ball forward-upward standing with the left foot forward; 4. Throwing a ball forward-upward standing with the left side to the throwing direction; 5. Throwing a ball at a target 3 m away.

Statistical Analysis

The study materials were processed by IBM SPSS 20 statistical analysis software. A discriminant analysis was carried out to determine the age-specific features of fundamental movement skills formation in boys aged 7 to 10. The level of proficiency in the aforementioned exercises was analyzed.

Results

Tables 1, 2 provide the group statistics of the level of proficiency in motor tasks for boys aged 7 to 10 which show that statistically significant differences in the level of proficiency are observed in exercises 1 to 4. The differences in the level of proficiency in exercise 5 "Throwing a ball at a target 3 m away" are statistically non-significant.

Table 3. Eigenvalues. Boys aged 7 to 10

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.381	64.5	64.5	0.762
2	0.738	34.4	98.9	0.652
3	0.023	1.1	100.0	0.150

Table 4. Wilks' Lambda. Boys aged 7 to 10

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 3	0.236	169.524	15	0.000
2 through 3	0.563	67.572	8	0.000
3	0.978	2.659	3	0.447

Based on the discriminant analysis results, it was established that the first canonical function explains 64.5% of the variation in results, while the second one does 34.4%, which indicates their high informativity ($r_1 = 0.762$; $r_2 = 0.652$) (see Table 3). The materials of the canonical function analysis show the statistical significance of the first and second canonical functions ($\lambda_1 = 0.236$; $p_1 = 0.001$; $\lambda_2 = 0.563$; $p_2 = 0.001$). The first and second functions have a high discriminative ability and value in interpretation with respect to the general population (see Table 4).

Table 5. Standardized Canonical Discriminant Function Coefficients. Boys aged 7 to 10

Content	Function		
	1	2	3
1. Throwing a ball against the floor	0.568	-0.012	0.603
2. Throwing a ball forward-upward standing feet apart	0.358	-0.829	-0.163
3. Throwing a ball forward-upward standing with the left foot forward	0.118	0.541	0.374
4. Throwing a ball forward-upward standing with the left side to the throwing direction	0.698	0.268	-0.537
5. Throwing a ball at a target 3 m away	-0.426	0.057	0.590

Table 6. Structure Matrix. Boys aged 7 to 10

Content	Function		
	1	2	3
4. Throwing a ball forward-upward standing with the left side to the throwing direction	0.664*	0.371	-0.313
2. Throwing a ball forward-upward standing feet apart	0.428	-0.732*	0.101
3. Throwing a ball forward-upward standing with the left foot forward	0.345	0.545*	0.266
1. Throwing a ball against the floor	0.555	-0.150	0.690*
5. Throwing a ball at a target 3 m away	-0.062	-0.057	0.565*

Table 7. Functions at Group Centroids. Boys aged 7 to 10

Ages 7 to 10	Function		
	1	2	3
7	1.223	0.311	-0.252
8	0.887	0.892	0.193
9	-1.734	0.379	-0.037
10	0.181	-1.270	0.054

Table 8. Classification Results. Boys aged 7 to 10

		Ages	Predicted Group Membership				
		7 to 10	7	8	9	10	Total
Original	Count	7	11	9	0	4	24
		8	6	21	0	1	28
		9	0	3	28	4	35
		10	3	0	1	32	36
	%	7	45.8	37.5	.0	16.7	100.0
		8	21.4	75.0	.0	3.6	100.0
		9	0.0	8.6	80.0	11.4	100.0
		10	8.3	0.0	2.8	88.9	100.0
Cross-validatedb	Count	7	11	9	0	4	24
		8	6	21	0	1	28
		9	0	3	27	5	35
		10	4	0	1	31	36
	%	7	45.8	37.5	.0	16.7	100.0
		8	21.4	75.0	.0	3.6	100.0
		9	0.0	8.6	77.1	14.3	100.0
		10	11.1	0.0	2.8	86.1	100.0

a. 74.8% of original grouped cases correctly classified. b. Cross validation is done only for those cases in the analysis. In cross validation, each case is classified by the functions derived from all cases other than that case. c. 73.2% of cross-validated grouped cases correctly classified.

The standardized coefficients of the canonical discriminant functions show that the largest contribution to the overall result is made by exercise 4 “Throwing a ball forward-upward standing with the left side to the throwing direction” (0.698) and exercise 1 “Throwing a ball against the floor” (0.568) (see Table 5).

The structure coefficients of the discriminant functions show that the functions are considerably related to the level of proficiency in exercise 4 “Throwing a ball forward-upward standing with the left side to the throwing direction” ($r=0.664$; the first function), exercise 2 “Throwing a ball forward-upward standing feet apart” ($r = -0.732$; the second function), exercise 5 “Throwing a ball at a target 3 m away” ($r = 0.565$; the third function). The analysis of the coefficients shows that the level of proficiency in exercise 4 “Throwing a ball forward-upward standing with the left side to the throwing direction” has the greatest effect on the process of throwing movement skills formation in boys aged 7 to 10. For boys aged 8 to 10, such an exercise is “Throwing a ball forward-upward standing feet apart”, and for boys aged 9 to 10, such an exercise is “Throwing a ball at a target 3 m away” (see Table 6).

Based on the results of classification of the age-specific features of throwing movement skills formation in boys aged 7 to 10, it was found that objects were correctly classified in 74.8% of cases (see Table 8). The group means (Functions at Group Centroids) for boys aged 7 to 10 show that the results of boys aged 7 are at the positive pole (1.223), while the results of boys aged 9 are at the negative pole (-1.734) (see Table 7). The graphic material provided in Figure 1 shows the density of the objects, a distinct boundary between the classes, and features in throwing movement skills formation in boys aged 7 to 10.

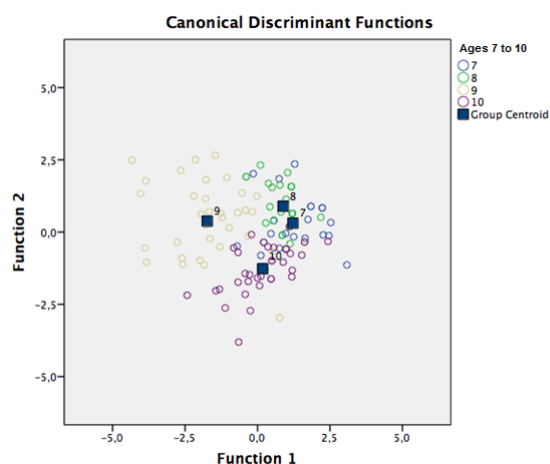


Fig. 1. Canonical discriminant functions. A graphical display of the results of classification of the age-specific features of throwing movement skills formation in boys aged 7 to 10: ■ — centroids for groups aged 7, 8, 9, and 10.

Discussion

The study assumed that discriminant analysis would make it possible to determine the age-specific features of throwing movement skills formation in boys aged 7 to 10. The results obtained allow to accept the assumption that it is possible to use the discriminant function to assess the age-specific features of throwing exercise skills formation in boys aged 7 to 10 and supplement the data on the use of the discriminant function in classifying students by their motor activity (Milić

et al., 2011; Gert-Jan de Bruijn, & Benjamin Gardner, 2011; Lulzim, 2013). Also, as in the studies by Medko and Khudolii (2021), Marchenko et al. (2021, 2022), we observed a high discriminative and prognostic ability of the obtained functions in the assessment of children's motor fitness.

The verification of the canonical functions shows their statistical significance, and the structure coefficients indicate the exercises that have an accentuated effect on throwing movement skills formation in boys aged 7 to 10. The discriminant analysis resulted in obtaining new data showing that the level of proficiency in exercise 4 "Throwing a ball forward-upward standing with the left side to the throwing direction" has the greatest effect on the process of throwing movement skills formation in boys aged 7 to 10. For boys aged 8 to 10, such an exercise is "Throwing a ball forward-upward standing feet apart", and for boys aged 9 to 10, such an exercise is "Throwing a ball at a target 3 m away". This confirms the conclusions of Barnett et al. (2009, 2016), Cools et al. (2011) on the importance of pointing out object control skills (throwing movement skills) as well as of pedagogical approaches in teaching FMS.

The data obtained supplement the results of the studies by Mathisen (2016), Nurulfa et al. (2021), Fernández-Valero et al. (2021) on the importance of ball exercise performance skills development in children, confirm the data of Akbar et al. (2021), Basman (2019), Iermakov et al. (2021) on the importance of FMS formation in children and adolescents as well as the data of Suprun et al. (2021), Shueva et al. (2021), Djordjevic et al. (2021) on the content component of learning.

The use of programmed learning in the process of throwing movement skills formation had a positive effect on both the effectiveness of mastering the movements by and increasing the motor activity of boys aged 7 to 10. The foregoing confirms the data on the need to combine the process of FMS formation with increasing the motor activity of children (Hulteen et al., 2018; Kalaja et al., 2010; Lai et al. 2014).

Conclusions

Discriminant analysis made it possible to determine the age-specific features of throwing movement skills formation in boys aged 7 to 10; answer the questions to which extent the differences in the effectiveness of skills formation in boys aged 7 to 10 are significant; which motor tasks are the most specific to boys aged 7, 8, 9, 10; which class an object belongs to based on the values of discriminant variables.

It was established that the level of proficiency in exercise 4 "Throwing a ball forward-upward standing with the left side to the throwing direction" has the greatest effect on the process of throwing movement skills formation in boys aged 7 to 10. For boys aged 8 to 10, such an exercise is "Throwing a ball forward-upward standing feet apart", and for boys aged 9 to 10, such an exercise is "Throwing a ball at a target 3 m away".

Conflict of interest

The authors declares that there is no conflict of interest.

References

Barnett, L. M., Hardy, L. L., Lubans, D. R., Cliff, D. P., Okely, A. D., Hills, A. P., & Morgan, P. J. (2013).

Australian children lack the basic movement skills to be active and healthy. *Health Promotion Journal of Australia*, 24(2), 82-84. <https://doi.org/10.1071/HE12920>

Chan, C., Ha, A., & Ng, J. Y. Y. (2016). Improving fundamental movement skills in Hong Kong students through an assessment for learning intervention that emphasizes fun, mastery, and support: The A + FMS randomized controlled trial study protocol. *SpringerPlus*, 5(1). <https://doi.org/10.1186/s40064-016-2517-6>

Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., & Okely, A. D. (2010). Fundamental movement skills in children and adolescents: Review of associated health benefits. *Sports Medicine*, 40(12), 1019-1035. <https://doi.org/10.2165/11536850-000000000-00000>

Barnett, L. M., Stodden, D., Cohen, K. E., Smith, J. J., Lubans, D. R., Lenoir, M., Iivonen, S., Miller, A. D., Laukkanen, A., Dudley, D., Lander, N. J., Brown, H., & Morgan, P. J. (2016). Fundamental movement skills: An important focus. *Journal of Teaching in Physical Education*, 35(3), 219-225. <https://doi.org/10.1123/jtpe.2014-0209>

Barnett, L. M., van Beurden, E., Morgan, P. J., Brooks, L. O., & Beard, J. R. (2009). Childhood Motor Skill Proficiency as a Predictor of Adolescent Physical Activity. *Journal of Adolescent Health*, 44(3), 252-259. <https://doi.org/10.1016/j.jadohealth.2008.07.004>

Cools, W., de Kristine, M., Samaey, C., & Andries, C. (2011). Fundamental movement skill performance of preschool children in relation to family context. *Journal of Sports Sciences*, 29(7), 649-660. <https://doi.org/10.1080/02640414.2010.551540>

Mathisen, G. E. (2016). Motor competence and implications in primary school. *Journal of Physical Education and Sport*, 16(1), 206-209.

Nurulfa, R., Lubis, J., Dlis, F., Aninggar, R., & Mamesah, E. (2021). Fundamental movement skills project: Efforts to keep children in Indonesia active during the pandemic. *Journal of Physical Education and Sport*, 21, 2350-2356. Scopus. <https://doi.org/10.7752/jpes.2021.s4315>

Fernández-Valero, P., Soto-Sánchez, J., Páez, J., Leyton-Dinamarca, B., Kain, J., Hurtado, J., & Reyes-Amigo, T. (2021). Fundamental movement skills and physical activity recommendations for preschool children. *Journal of Physical Education and Sport*, 21, 3286-3293. <https://doi.org/10.7752/jpes.2021.s6436>

Akbar, Z., Awalludin, & Tohar, K. (2021). Fundamental movement skills and sensory movement strategies to support online learning in early childhood. *Journal of Physical Education and Sport*, 21, 2364-2371. <https://doi.org/10.7752/jpes.2021.s4317>

Basman, A. J. (2019). Assessment criteria of fundamental movement skills for various age groups: A systematic review. *Journal of Physical Education and Sport*, 19(1), 722-732. <https://doi.org/10.7752/jpes.2019.01104>

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. *Physical Education Theory and Methodology*, 21(1), 77-83. <https://doi.org/10.17309/tmfv.2021.1.10>

- Sulistiyono, S., Akhiruyanto, A., Primasoni, N., Arjuna, F., Santoso, N., & Yudhistira, D. (2021). The Effect of 10 Weeks Game Experience Learning (Gel) Based Training on Teamwork, Respect Attitude, Skill and Physical Ability in Young Football Players. *Physical Education Theory and Methodology*, 21(2), 173-179. <https://doi.org/10.17309/tmfv.2021.2.11>
- Samsudin, S., Setiawan, I., Taufik, M., & Solahuddin, S. (2021). Volleyball Fundamental Movement Learning Model in Primary School. *Physical Education Theory and Methodology*, 21(3), 194-199. <https://doi.org/10.17309/tmfv.2021.3.02>
- Dudley, D., Okely, A., Pearson, P., & Cotton, W. (2011). A systematic review of the effectiveness of physical education and school sport interventions targeting physical activity, movement skills and enjoyment of physical activity. *European Physical Education Review*, 17(3), 353-378. <https://doi.org/10.1177/1356336X11416734>
- Marchenko, S., & Handymov, B. (2021). Development of Strength Abilities Using Play Techniques with Elements of Martial Arts at the Sports and Recreational Stage in 10-Year-Old Girls. *Journal of Learning Theory and Methodology*, 2(2), 68-74. <https://doi.org/10.17309/jltm.2021.2.03>
- Marchenko, S., & Satdyiev, B. (2021). Effectiveness of Using Active Games for Strength Development in 10-Year-Old Boys at the Initial Training Stage in Kyokushin Karate. *Physical Education Theory and Methodology*, 21(1), 84-89. <https://doi.org/10.17309/tmfv.2021.1.11>
- Ivashchenko, O., Nosko, M., Nosko, Y., & Chernenko, S. (2019). Pattern Recognition: Description of Modes of Teaching Boys Aged 7 Throwing a Small Ball at a Vertical Target. *Physical Education Theory and Methodology*, 19(3), 130-138. <https://doi.org/10.17309/tmfv.2019.3.04>
- Ivashchenko, O., Khudolii, O., Iermakov, S., Chernenko, S., & Honcharenko, O. (2018). Full factorial experiment and discriminant analysis in determining peculiarities of motor skills development in boys aged 9. *Journal of Physical Education and Sport*, 18, 1958-1965. <https://doi.org/10.7752/jpes.2018.s4289>
- Ivanov, D., Ivashchenko, O., & Bartik, P. (2021). Pattern Recognition: Effectiveness of Teaching Boys Aged 15 a Cartwheel. *Journal of Learning Theory and Methodology*, 2(3), 105-110. <https://doi.org/10.17309/jltm.2021.3.01>
- Kalistratova, I., & Khudolii, O. (2021). Pattern Recognition: Effectiveness of Teaching Girls Aged 14 the Cartwheel. *Journal of Learning Theory and Methodology*, 2(3), 140-145. <https://doi.org/10.17309/jltm.2021.3.06>
- Bezzub, A., Khudolii, O., & Muszkieta, R. (2021). Pattern Recognition: Modes of Developing Motor Skills of Acrobatic Exercises in Boys Aged 14. *Journal of Learning Theory and Methodology*, 2(1), 41-46. <https://doi.org/10.17309/jltm.2021.1.06>
- Suprun, A., Ivashchenko, O., & Cieřlicka, M. (2021). Didactics: Peculiarities of Programmed Teaching of a Cartwheel to Boys Aged 14. *Journal of Learning Theory and Methodology*, 2(3), 128-133. <https://doi.org/10.17309/jltm.2021.3.04>
- Shueva, A., Ivashchenko, O., & Jagiello, W. (2021). Motor Skills Development: Peculiarities of Programmed Teaching of Acrobatic Exercises to Girls Aged 15. *Physical Education Theory and Methodology*, 21(4), 350-356. <https://doi.org/10.17309/tmfv.2021.4.10>
- Pambudi, A., Sugiyanto, S., Hidayatullah, F., & Purnama, S. (2021). Physical Activity Model to Develop Basic Movement Skills in Kindergarten Students Based on Physical Literacy. *Physical Education Theory and Methodology*, 21(4), 323-329. <https://doi.org/10.17309/tmfv.2021.4.06>
- Septaliza, D., Hanif, A., & Yusmawati, Y. (2022). Jump Movement Skills Pattern Among Indonesia Mentally Retarded Children Using D-Mat. *Physical Education Theory and Methodology*, 22(1), 128-133. <https://doi.org/10.17309/tmfv.2022.1.18>
- Medko, D., & Khudolii, O. (2021). Pattern Recognition: Effectiveness of Teaching Girls Aged 15 Acrobatic Exercises. *Journal of Learning Theory and Methodology*, 2(3), 134-139. <https://doi.org/10.17309/jltm.2021.3.05>
- Marchenko, S., Ivashchenko, O., Jagiello, W., Iermakov, S., Khudolii, O., & Yermakova, T. (2022). Discriminant analysis: Features of training 10-year-old boys in the technique of kicks in kyokushin karate. *Archives of Budo*, 18, 1-11.
- 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.
- Marchenko, S., & Taranenko, O. (2020). Managing the Effectiveness of Teaching Boys Aged 10 Mawashi-Geri (Roundhouse Kick) Technique in Kyokushin Karate. *Physical Education Theory and Methodology*, 20(4), 262-268. <https://doi.org/10.17309/tmfv.2020.4.10>
- Djordjevic, I., Valkova, H., & Petkovic, E. (2021). Differences of Motor Proficiency in Preschool Girls Related to Organized Physical Activity. *Physical Education Theory and Methodology*, 21(4), 357-364. <https://doi.org/10.17309/tmfv.2021.4.11>
- Milić, M., Milavić, B., & Grgantov, Z. (2011). Relations between sport involvement, selfesteem, sport motivation and types of computer usage in adolescents. In S. Simović (Ed.), *Proceedings of 3rd International Scientific Congress "Anthropological Aspects of Sport, Physical Education and Recreation"*. November 2011. Banja Luka: University of Banja Luka, Faculty of Physical Education and Sport.
- Gert-Jan de Bruijn and Benjamin Gardner (2011) Active Commuting and Habit Strength: An Interactive and Discriminant Analyses Approach. *American Journal of Health Promotion*, 25(3), e27-e36. <https://doi.org/10.4278/ajhp.090521-QUAN-170>
- Lulzim, I., (2013) Discriminant analysis of morphologic and motor parameters of athlete and non athlete girl pupils of primary school on age 14 to 15 years. *RIK(2012)*, 40(2), 185-190.
- Hulteen, R. M., Morgan, P. J., Barnett, L. M., Stodden, D. F., & Lubans, D. R. (2018). Development of Foundational Movement Skills: A Conceptual Model for Physical Activity Across the Lifespan. *Sports Medicine*, 48(7), 1533-1540. <https://doi.org/10.1007/s40279-018-0892-6>

Kalaja, S., Jaakkola, T., Liukkonen, J., & Watt, A. (2010). Fundamental movement skills and motivational factors influencing engagement in physical activity. *Perceptual and Motor Skills*, 111(1), 115-128. <https://doi.org/10.2466/06.10.25.PMS.111.4.115-128>

Lai, S. K., Costigan, S. A., Morgan, P. J., Lubans, D. R., Stodden, D. F., Salmon, J., & Barnett, L. M. (2014). Do

school-based interventions focusing on physical activity, fitness, or fundamental movement skill competency produce a sustained impact in these outcomes in children and adolescents? A systematic review of follow-up studies. *Sports Medicine*, 44(1), 67-79. <https://doi.org/10.1007/s40279-013-0099-9>

РОЗПІЗНАННЯ ОБРАЗІВ: ВІКОВІ ОСОБЛИВОСТІ ФОРМУВАННЯ ОСНОВНИХ РУХОВИХ НАВИЧОК У ШКОЛЯРІВ МОЛОДШИХ КЛАСІВ

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

Реферат. Стаття: 7 с., 8 табл., 1 рис., 37 джерел.

Мета роботи – визначити вікові особливості формування основних рухових навичок у школярів молодших класів.

Матеріали і методи. У дослідженні прийняли участь хлопчики 7-10 років (7 років – 24 чол.; 8 років – 28 чол.; 9 років – 35 чол.; 10 років – 36 чол.). Діти та їхні батьки або законні опікуни були повністю інформовані про всі особливості дослідження, згоду було отримано від усіх батьків. Протокол дослідження був затверджений Етичним комітетом університету.

Досліджувалися особливості навчання метанню м'яча у вертикальну ціль хлопчиків 7-10 років. Рівень навченості кидкових вправ у занятті оцінювався альтернативним методом («виконав», «не виконав»), розраховувалася вірогідність виконання вправи ($p = n/m$, де n – кількість успішно виконаних спроб, m – загальна кількість спроб). У навчанні хлопчиків 7-10 років використовувався метод алгоритмічних розпоряджень. Матеріали дослідження опрацьовані в програмі статистичного аналізу – IBM SPSS 20. Був проведений дискримінантний аналіз.

Результати. Встановлено, що перша канонічна функція пояснює варіацію результатів на 64,5%, а друга – на 34,4%, що свідчить про їх високу інформативність ($r_1 = 0,762$; $r_2 = 0,652$). Матеріали аналізу канонічних функцій вказують на статистичну значущість першої і другої канонічної функції ($\lambda_1 = 0,236$; $p_1 = 0,001$; $\lambda_2 = 0,5633$; $p_2 = 0,001$). Перша і друга функція мають високу дискримінантну здатність і значення в інтерпретації відносно генеральної сукупності.

Висновки. Дискримінантний аналіз дозволив визначити вікові особливості формування кидкових навичок у хлопчиків 7-10 років; дати відповідь на питання наскільки достовірно різняться результативність формування навичок у хлопчиків 7-10 років; які рухові завдання є найбільш характерні для хлопчиків 7, 8, 9, 10 років; до якого класу належить об'єкт на основі значень дискримінантних змінних.

Встановлено, що рівень навченості вправі 4 «Кидки м'яча вперед-угору з вихідного положення стійка лівим боком у бік метання» має найбільший вплив на процес формування навичок кидкових рухів у хлопчиків 7-10 років. Для хлопчиків 8-10 років такою вправою є «Кидки м'яча вперед-угору з вихідного положення стійка ноги нарізно», а для хлопчиків 9-10 років – «Кидки м'яча у ціль з відстані 3 м».

Ключові слова: основні рухові навички, хлопчики, дискримінантний аналіз.

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