

Assessment of reaction speed and nervous system characteristics: implications for physical exercise selection in humanities students' physical education

ZHANNETA KOZINA¹, YAROSLAVA BEREZHNA¹, YURII BOYCHUK², OLEKSII KOZIN¹, YULIIA GOLENKOVA³, STANISLAV POLISHCHUK¹, SWAMYNATHAN SANJAYKUMAR⁴

¹Department of Olympic and Professional Sport, Sport Games and Tourism, H.S. Skovoroda Kharkiv National Pedagogical University, UKRAINE

²H.S. Skovoroda Kharkiv National Pedagogical University, UKRAINE

³Department of sports and pedagogical disciplines and fitness, H.S. Skovoroda Kharkiv National Pedagogical University, UKRAINE

⁴ Department of Physical Education and Sports Sciences, Faculty of Science and Humanities, SRM Institute of Science and Technology, Kattankulathur, INDIA

Published online: March 31, 2024

(Accepted for publication March 15, 2024)

DOI:10.7752/jpes.2024.03062

Abstract

Background and purpose. The current state of student physical education underscores the growing relevance of tailoring physical exercises to individual interests, abilities, and capabilities. The purpose of the study is to identify the characteristics of the nervous processes of students of humanities (philological and historical) specialties and, on their basis, to develop recommendations for independent physical education.

Material and method. We have tested 693 students of the H.S. Skovoroda Kharkiv National Pedagogical University. Among the students was surveyed, 66 students studied in the specialty “history”, 116 students were future teachers of foreign languages, 154 students were future specialists in Ukrainian philology, the remaining students studied in other specialties. The study was conducted in September 2022 via online testing under the Psychodiagnostics program. Students were tested to determine the latent time of the reaction in different modes: the first mode - determination of the latent time of a simple response to a signal; mode 2 – determination of latent reaction time under feedback conditions. The average value of the latent time of response to exposure and the average value of the quantity of mistakes were determined. **Results.** Students – future teachers of history, foreign language and Ukrainian language occupy an intermediate position between future teachers of primary (preschool) education and future teachers of fine arts in terms of liveness and endurance of the nervous processes. They have a lower level of liveness and a higher level of endurance of the nervous processes compared to future teachers of preschool and primary education. They also have a higher level of liveness and a lower level of endurance of the nervous processes compared to students - future teachers of fine arts. **Conclusions.** The study made it possible to identify the characteristics of the nervous processes of students – future teachers of history and philology. In terms of liveness and endurance of the nervous processes, they occupy an intermediate position between students – future specialists in teaching primary school and preschool children and future specialists in the field of fine arts. Physical education classes for students studying in the specialties “history”, “foreign language” and “Ukrainian language” must correspond to the characteristics of their nervous processes. We recommend to future history teachers include more cyclic exercises in their classes that correspond to the property of their nervous processes such as endurance, and we recommend to future teachers of foreign and Ukrainian languages include more outdoor and sports games in their classes; in online learning conditions include more exercises with the ball.

Keywords: students, physical education, history, philology, nervous processes, exercises

Introduction

Currently, the relevance of physical education for students is increasing (Pavlovic, 2024, Lobo, et. all, 2023, Kozin, et. all, 2023a, Kozin, et. all, 2022, Yuniana, et. all, 2023). This is due to an increase in physical inactivity among students. This is especially true for the last three to four years due to the increase in the share of online learning due to pandemics, wars and other social, political and epidemiological factors (Gani, et. all, 2023, Chen, et. all, 2022, Cochon Drouet, O, et. all, 2024, Jiang Qing, et. all, 2023). Online learning creates the greatest difficulties for physical education and sports training of students. Students are forced to practice on their own, without teachers correcting the correct execution of technically complex movements (Tsyhura, & Harkusha, 2023, Kozin, et. all, 2023b, Lu, et. all, 2023, Chen, et. all, 2023, Shao, et. all, 2023, Zhou, et. all, 2023, Flemons, et. all, 2024). Classes in team interactions are also difficult, which is typical for team sports, martial arts, and also for all forms of physical education that require communication between students. As a

result of online learning, the most vulnerable are the most widespread types and forms of organizing physical exercises, which are usually very popular among students, that is, team sports, martial arts, dancing, aerobics, and so on (Tsyhura, & Harkusha, 2023, Kozin, et. all, 2023b, Lu, et. all, 2023, Chen, et. all, 2023).

On the other hand, online learning creates an opportunity in physical education to search for effective directions for an individual approach to classes. However, this requires the student's ability and determination to take responsibility for his own physical activity, its types, volume, intensity, routine, and so on. In order for students whose main specialization is not related to physical education and sports to have a desire to perform physical exercises, it is first of all necessary that they enjoy these exercises (Simonton, et. all, 2023, Burgueño, et. all, 2023, Grástén, et. all, 2023, Martos-Garcia, et. all, 2023). This is especially true for physical exercises that students need to perform independently, without supervision from teachers. The question arises: how to choose physical exercises for university students in such a way that they like them? The solution to this issue is easier if a student already has experience in sports or various types of physical activity. In this case, a student already knows what sports and physical activity he (she) likes and what he (she) doesn't. However, students may or may not have such experience. If the student does not have such experience, then teachers should help him choose a sport or physical activity. And in this case, the difficulty arises in selecting exercises (type of sport, physical activity) for the student in such a way that it suits him (her) and likes it. To do this, exercises should develop not only physical aspects, but also cognitive ones, which are approach to them professional activity (Martos-Garcia, et. all, 2023, Kinder, et. all, 2023, Kaloka, et. all, 2023, Zhou, et. all, 2023, Salvador- Garcia Zhou, et al., 2024). Only in this case will the student study independently and with pleasure, which is a necessary condition for constant studies, increasing the level of physical fitness, maintaining and strengthening health. Naturally, in conditions of limited time, which is studying at the university, in combination with online learning, the student's choice of exercises (sport or physical activity) by trying them out one by one is a difficult task (Pavlovic, & Siryi, 2023, Kozin, & Matlaiev, 2023, Bujdoš, et. all, 2023, Kozina, Z., et. all, 2022).

How can we help students choose exercises for physical education so that they suit them, that is, they like them and give maximum pleasure when performing them? Obviously, the selection of exercises for university students should be based on their individual characteristics of the properties of the nervous processes, functional and physical capabilities, inclinations and interests.

In our previous studies (Kozin, et. all, 2022, Kozin, et. all, 2023a, 2023b) it was shown that, indeed, there are professional characteristics of students of the Art Faculty and faculties of preschool and primary education according to psychophysiological characteristics. Students of the Art Faculty are characterized by high levels of stability and endurance of the nervous processes, that is, the ability to work for a long time without errors. At the same time, students of the Art Faculty are characterized by low levels of nervous processes liveness, i.e. ability to shift attention. Students of the faculties of preschool and primary education, on the contrary, are characterized by high rates of liveness of the nervous processes and low rates of stability and endurance of the nervous processes. stems. Based on the results obtained, recommendations were developed for a differentiated selection of exercises for students of these faculties. The application of these recommendations in the physical education of students has shown the high efficiency of selecting physical exercises according to the characteristics of the properties of the nervous processes of students, which is closely related to their future professional specialization (Kozin, et. all, 2022, Kozin, et. all, 2023a, 2023b).

The question arises: do students of other humanities specialties, for example, philology and history, differ from representatives of other faculties in the properties of the nervous processes, and are there physical exercises that are suitable specifically for these students?

In this regard, this study posed a hypothesis: there are features of reaction speed indicators in various testing modes and the properties of the nervous processes among students of historical and philological specialties, on the basis of which exercises for independent online physical education classes should be selected.

The purpose of the study is to identify the characteristics of the nervous processes of students of humanities (philological and historical) specialties and, on their basis, to develop recommendations for independent physical education.

Material and methods

Participants

We have tested 693 students of the H.S. Skovoroda Kharkiv National Pedagogical University, Ukraine. Among the students was been surveyed, 69 received the specialty of primary school teachers, 66 students studied in the specialty "history", 110 students were future biologists, 116 were future teachers of foreign languages, 82 students were trained as preschool teachers, 154 students were future specialists in Ukrainian philology, 31 students were specialists in the field of physical education and sports, 29 students specialized in fine arts and design, 36 students specialized in sociology and psychology.

Study design

The study was conducted in September 2022 via online testing under the Psychodiagnostics program. The goals, conditions and rules of conduct for testing were explained to the students. Students were tested in the morning from 9-00 to 9-30.

Testing was carried out as follows. First, students were explained what the purpose of the study was. They were informed that they would be tested to determine the latent time of reaction in different testing modes: the first mode - determination of the latent time of a simple response to a signal; Mode 2 – determination of latent reaction time under feedback conditions, in which, as the response time to a signal decreases, the time between signals also decreases. The total number of signal exposures is 50. The average value of the latent time of response to the exposure and the average value of the quantity of mistakes for each student are determined. The fewer the quantity of mistakes, the higher the endurance of the nervous processes. The shorter the latent time to respond to a signal, the higher the liveness of the nervous processes (Kozin, et. all, 2022, Kozin, et. all, 2023a, 2023b).

Statistical analysis

First, all student samples were checked for compliance with the normal distribution using the Kolmogorov-Smirnov method. Since all samples of examined students corresponded to a normal distribution, students from different professional specializations were compared using the Student's t-test. Students of philological specialties (foreign languages and Ukrainian language), future history teachers were compared with students of other specializations. Differences were considered significant at a significance level of less than 0.05.

Results

The results of the study confirmed our assumption that students of certain humanitarian specialties, such as history and philology, are significantly different from representatives of other specialties (biology, preschool and primary education, sociology and psychology, physical education and sports, art) in a number of indicators of the functioning of the nervous processes. Even according to the most basic test for determining the latent time of a simple response to a signal, future history teachers have significantly higher latent reaction time indicators (reaction speed is significantly lower) compared to future biology teachers, primary school teachers and preschool teachers ($p < 0.05$) (Table 1). Also, the latent reaction time is significantly higher for future foreign language teachers compared to future preschool teachers compared to future primary school teachers and significantly lower compared to future fine arts teachers ($p < 0.05$) (Table 1). Future teachers of the Ukrainian language have a significantly higher latent reaction time (reaction speed, accordingly, significantly lower) compared to future primary school teachers, preschool teachers and coaches in their chosen sport, and compared to future fine arts teachers, reaction time significantly lower (reaction speed significantly higher) (Table 1).

Table 1

The results of the verification of the reliability of the differences in the indicators nervous processes (Time of a simple response, ms) of students of different specialties of pedagogical universities

PS		1 (n=69)	2 (n=66)	3 (n=110)	4 (n=116)	5 (n=82)	6 (n=154)	7 (n=31)	8 (n=29)	9 (n=36)
PS	\bar{X} , ms	338.603	393.15	367.04	414.52	355.56	421.94	403.75	509.5	393.0
	S, ms	4.53	67.23	74.14	87.17	72.66	80.51	142.45	41.26	37.6
2	t	3.36								
	p	0.00								
3	t	1.973	2.411							
	p	0.01	0.00							
4	t	3.145	1.639	1.349						
	p	0.00	0.09	0.052						
5	t	2.627	1.777	1.560	1.371					
	p	0.00	0.04	0.015	0.047					
6	t	3.547	1.471	1.786	0.633	1.940				
	p	0.00	0.026	0.03	0.818	0.01				
7	t	1.615	0.942	1.024	0.879	0.894	0.996			
	p	0.011	0.338	0.245	0.422	0.400	0.274			
8	t	-3.437	2.354	2.431	1.934	2.68	1.836	1.414		
	p	0.01	0.00	0.00	0.01	0.0	0.02	0.037		
9	t	2.105	1.969	1.288	1.022	0.866	1.422	0.816	2.041	-
	p	0.00	0.06	0.073	0.247	0.441	0.035	0.518	0.00	-

Notes: PS - professional specialization: 1 - primary school teacher, 2 - history teacher, 3 - biology teacher, 4 - foreign language teacher, 5 - preschool teacher, 6 - Ukrainian language teacher, 7 - trainer in selected sport, 8 - fine arts teacher, 9 - sociologist (psychologist); \bar{X} - group average value of the latent reaction time of the simple response test (ms), S - standard deviation, t - Student's test criterion, p - significance level

Thus, in terms of the speed of a simple response to a signal, students of the specialty's "history", "foreign language" and "Ukrainian language" significantly differ in the direction of increasing the latent reaction time and, accordingly, decreasing the reaction speed, from students of the specialties "primary education", "preschool education", "biology" ($p < 0.05$). At the same time, the reaction speed indicators of students - future teachers of history, foreign languages and the Ukrainian language are significantly lower compared to future teachers of fine arts ($p < 0.05$) (Table 1).

We also obtained similar results for the rate of reaction to a signal in feedback mode. For students - future teachers of history, foreign language and Ukrainian language, the latent time of reaction to a signal in feedback mode is significantly higher (accordingly, the reaction speed is significantly lower) compared to students - future teachers of primary school, biology and preschool teachers ($p < 0.05$) (Table 2). At the same time, future historians and philologists have significantly lower latent reaction time indicators (correspondingly, higher reaction speed) compared to future fine arts teachers ($p < 0.05$) (Table 2). Since the speed of reaction in the feedback mode reflects the liveness of the nervous processes, we can conclude that future teachers of history and philology significantly differ from future primary school teachers and educators in preschool institutions in the direction of a less mobile nervous processes, and from future teachers of fine arts, on the contrary, in side of the more mobile nervous processes.

A comparison of future teachers of history, a foreign language and the Ukrainian language with each other according to these indicators showed that the least mobile nervous processes is among future historians, and the most mobile is among future teachers of the Ukrainian language. Future foreign language teachers occupy an intermediate position in terms of nervous processes liveness in this comparison ($p < 0.05$). Also, all students, future teachers of history and philology, who were specifically compared in this study with representatives of other specializations, in terms of nervous processes liveness, occupy an intermediate position between future teachers of preschool education and primary education.

Table 2

The results of checking the reliability of the differences in indicators of psychophysiological functions (response time for choosing two elements out of three) of students of different faculties of pedagogical universities

PS	PS	1 (n=69)	2 (n=66)	3 (n=110)	4 (n=116)	5 (n=82)	6 (n=154)	7 (n=31)	8 (n=29)	9 (n=36)
	\bar{x} , ms		449.13	573.75	484.12	542.86	522.27	531.24	519.75	577.5
S, ms		55.38	67.44	57.14	77.69	78.7	91.4	72.01	66.08	47.1
2	t	1.242								
	p	0.091								
3	t	1.467	3.606							
	p	0.027	0.00							
4	t	5.269	2.213	3.732						
	p	0.00	0.0	0.00						
5	t	4.119	1.721	2.800	1.363					
	p	0.00	0.05	0.00	0.049					
6	t	5.147	1.414	3.795	1.575	1.139				
	p	0.00	0.037	0.00	0.014	0.150				
7	t	2.546	1.732	1.904	0.827	1.871	2.668			
	p	0.00	0.05	0.01	0.501	0.02	0.00			
8	t	-4.084	1.732	1.638	1.300	1.185	1.113	0.707		
	p	0.00	0.05	0.09	0.068	0.121	0.168	0.699		
9	t	43	1.643	3.239	1.142	1.294	1.722	1.633	1.225	-
	p	0.00	0.09	0.00	0.147	0.070	0.05	0.010	0.100	-

Notes: PS - professional specialization, Student specialties: 1 - primary school teacher, 2 - history teacher, 3 - biology teacher, 4 - foreign language teacher, 5 - preschool teacher, 6 - Ukrainian language teacher, 7 - trainer in selected sport, 8 - fine arts teacher, 9 - sociologist (psychologist); \bar{x} - group average value of the latent response time of choosing two elements out of three (ms), S - standard deviation, t - Student's test criterion, p - significance level

However, in terms of the quantity of mistakes in the test for determining latent response time, future history and philology teachers showed significantly better results compared to future primary school and preschool teachers, and significantly worse results compared to future fine arts teachers ($p < 0.05$) (Table 3). The quantity of mistakes in the response speed test in feedback mode reflects the endurance and strength of the nervous processes. The fewer errors in this test, the more stable the nervous processes.

In this regard, we can conclude that students – future teachers of history, foreign language and Ukrainian language occupy an intermediate position between future teachers of primary (preschool) education and future teachers of fine arts in terms of liveness and endurance of the nervous processes. They have a lower level of liveness and a higher level of nervous processes compared to future teachers of preschool and primary education. They also have a higher level of liveness and a lower level of endurance of the nervous processes compared to students - future teachers of fine arts. At the same time, future historians and philologists also differ significantly ($p < 0.05$) from each other. Students - future history teachers have a significantly lower response speed in all testing modes and, accordingly, liveness of the nervous processes, and a significantly higher mental endurance compared to students - future foreign language teachers and, especially, compared to future teachers of the Ukrainian language. Students - future foreign language teachers occupy an intermediate place between future history teachers and future teachers of the Ukrainian language.

Table 3

Results of verification of the reliability of the indicators of psychophysiological functions (Tests in the response hour test for the choice of 2 elements from 3, as many as possible) of students from various faculties of the Pedagogical University

	PS	1 (n=69)	2 (n=66)	3 (n=110)	4 (n=116)	5 (n=82)	6 (n=154)	7 (n=31)	8 (n=29)	9 (n=36)
PS	\bar{x} , ms	19.4	6.13	2.28	6.49	12.67	5.25	2.00	1.25	7.5
	S, ms	4.05	1.18	0.78	1.92	2.61	1.73	0.82	0.26	1.14
2	t	3.388								
	p	0.00								
3	t	3.514	3.017							
	p	0.00	0.00							
4	t	4.938	37	1.423						
	p	0.00	0.0	0.035						
5	t	4.119	2.741	1.778	1.589					
	p	0.00	0.00	0.04	0.013					
6	t	6.720	2.715	1.246	1.336	1.752				
	p	0.00	0.00	0.090	0.056	0.04				
7	t	3.726	3.266	1.051	1.759	1.604	1.603			
	p	0.00	0.00	0.219	0.04	0.012	0.012			
8	t	-6.464	3.266	0.404	1.759	2.192	1.603	1.414		
	p	0.00	0.00	0.997	0.04	0.00	0.012	0.037		
9	t	3.714	2.500	1.320	0.915	0.914	1.153	1.633	1.633	-
	p	0.00	0.00	0.061	0.372	0.374	0.140	0.010	0.01	-

Notes: PS - professional specialization, Student specialties: 1 - primary school teacher, 2 - history teacher, 3 - biology teacher, 4 - foreign language teacher, 5 - preschool teacher, 6 - Ukrainian language teacher, 7 - trainer in selected sport, 8 – fine arts teacher, 9 – sociologist (psychologist); \bar{x} – group average value of the quantity of mistakes in the test for determining the latent response time of choosing two elements out of three (quantity), S – standard deviation, t – Student’s test criterion, p – significance level

Discussion

The hypothesis posed in this study was confirmed. We found that students of philological and historical specialties at the Pedagogical University significantly differ from representatives of other pedagogical specialties in terms of response speed in different testing modes. We found that students – future teachers of history, foreign languages and the Ukrainian language are significantly different from students – future teachers of preschool education and primary school in terms of response speed. Students – future teachers of history and philology have a significantly longer latent response time and, accordingly, a lower response speed compared to future

teachers of primary school and preschool education. This also applies to a simple response to a signal and the response of choosing two elements out of three in feedback mode. At the same time, the indicators of students – future teachers of history and philology are significantly lower latent response time and, accordingly, higher response speed compared to students – future teachers of fine arts. Accordingly, the liveness of the nervous processes of future teachers of history, foreign language and Ukrainian language occupies an intermediate position between future specialists in preschool and primary education and future specialists in the field of fine arts: it is less than that of students of preschool and primary education and higher than that of students, specializing in the field of fine arts.

Regarding the indicators of endurance of the nervous processes, which was determined by the quantity of mistakes in the response speed test in feedback mode, it was found that students studying in the specialties “history”, “foreign language” and “Ukrainian language” had significantly less the quantity of mistakes in this test compared to students studying in the specialties “preschool education” and “primary education”. This indicates that students – future teachers of history and philology have significantly higher endurance of the nervous processes compared to students studying in the specialties “primary education” and “preschool education”, and significantly higher indicators of endurance of the nervous processes. At the same time, these students have significantly lower indicators of endurance of the nervous processes compared to students who are future teachers of fine arts.

We can explain the revealed dates by the fact that students, when entering university, intuitively choose specialties that suit them according to their properties of the nervous processes (Pavlovic, & Siryi, 2023, Kozin, & Matlaiev, 2023, Bujdos, et. all, 2023, Kozina, Z., et.all, 2022). Thus, those who have a predominant liveness of the nervous processes choose specialties that require frequent switching of attention, for example, working with small children, i.e. – faculties of preschool and primary education (Pavlovic, & Siryi, 2023, Kozin, & Matlaiev, 2023, Bujdos, et. all, 2023, Kozina, Z., et. all, 2022). Students who, on the contrary, have less liveness of the nervous processes and higher endurance of the nervous processes, choose specialties where it is necessary to maintain concentration on something for a long time without making mistakes. These specialties include fine arts (Kozin, et. all, 2022, Kozin, et. all, 2023a, 2023b). History classes also require high concentration of attention, so it is no coincidence that future history teachers take second place among the students surveyed after fine arts students in terms of endurance of the nervous processes. Next after future history teachers are students specializing in foreign languages and the Ukrainian language.

Based on the data obtained, we can recommend it to students studying history majors, “foreign language” and “Ukrainian language” exercises that require endurance and concentration, for example, cyclic exercises (long walking, running, swimming, cycling, and so on). We can also recommend to these students exercises that require the manifestation of the liveness of the nervous processes and switching attention: gymnastic complexes with a large number of exercises and their frequent change, sports and outdoor games, martial arts.

Since students – future teachers of history and philology have an average and the severity of both liveness and endurance of the nervous processes, then they can be recommended to engage in both cyclic types of physical activity, as well as outdoor and sports games, as well as martial arts. They can also use gymnastics complexes with a large number of exercises that require both concentration and switching of attention. Certainly, these recommendations apply exclusively to students who find it difficult to choose their sport or physical activity. At the next stages of our research, it is planned to develop and substantiate special methods of physical culture for students of humanities.

Conclusions

1. In terms of the speed of a simple response to a signal, students of the specialties “history”, “foreign language” and “Ukrainian language” significantly differ in the direction of increasing the latent response time and, accordingly, decreasing the response speed, from students of the specialties “primary education”, “preschool education”, “biology” ($p < 0.05$). At the same time, the response speed indicators of students – future teachers of history, foreign languages and the Ukrainian language are significantly lower compared to future teachers of fine arts ($p < 0.05$).

2. For students – future teachers of history, foreign language and Ukrainian language, the latent time of response to a signal in the feedback mode is significantly higher (accordingly, the response speed is significantly lower) compared to students – future teachers of primary school, biology and preschool teachers ($p < 0.05$). Future historians and philologists have significantly lower latent response time indicators (correspondingly, higher response speed) compared to future fine arts teachers ($p < 0.05$). Future teachers of history and philology significantly differ from future primary school teachers and educators in preschool institutions in the direction of a less mobile nervous processes, and from future teachers of fine arts, on the contrary, in the direction of a more mobile nervous processes.

3. In terms of the quantity of mistakes in the test for determining the latent response time, future history and philology teachers showed significantly better results compared to future primary school and preschool teachers and significantly worse results compared to future fine arts teachers ($p < 0.05$).

4. Students – future teachers of history, foreign language and Ukrainian language occupy an intermediate position between future teachers of primary (preschool) education and future teachers of fine arts in terms of liveness and endurance of the nervous processes. They have a lower level of liveness and a higher level of endurance of the nervous processes compared to future teachers of preschool and primary education. They also have a higher level of liveness and a lower level of endurance of the nervous processes compared to students - future teachers of fine arts.

5. The study made it possible to identify the characteristics of the nervous processes of students - future teachers of history and philology. In terms of liveness and endurance of the nervous processes, they occupy an intermediate position between students – future specialists in teaching primary school children and future specialists in the field of fine arts. Therefore, physical education classes for students studying in the specialties “history”, “foreign language” and “Ukrainian language” must correspond to the characteristics of their nervous processes. We recommend that future history teachers include in their classes more exercises of a cyclic nature, which correspond to such a property of their nervous processes as endurance, and we recommend that future teachers of foreign and Ukrainian languages include more active and sports games in their classes, in the conditions of learning in the mode online – more exercises with the ball.

References

- Bujdoš, G., Adamčák, Štefan, Marko, M., & Bartík, P. (2023). The use of smartphones in the physical activities of adolescent girls in Slovakia and the Czech Republic. *Health-Saving Technologies, Rehabilitation and Physical Therapy*, 4(1), 7–19. <https://doi.org/10.58962/HSTRPT.2023.4.1.7-19>
- Burgueño, R., García-González, L., Abós, Á., & Sevil-Serrano, J. (2023). Students' need satisfaction and frustration profiles: Differences in outcomes in physical education and physical activity-related variables. *European Physical Education Review*, 29(4), 563-581. <https://doi.org/10.1177/1356336X231165229>
- Chen, G., Chen, P., Huang, W., & Zhai, J. (2022). Continuance intention mechanism of middle school student users on online learning platform based on qualitative comparative analysis method. *Mathematical Problems in Engineering*, 3215337, 12. <https://doi.org/10.1155/2022/3215337>
- Chen, H., Xiong, Y., Li, S., Song, Z., Hu, Z., & Liu, F. (2022). Multi-sensor data driven with PARAFAC-IPSO-PNN for identification of mechanical nonstationary multi-fault mode. *Machines*, 10(2), 155. <https://doi.org/10.3390/machines10020155>
- Cochon Drouet, O., Margas, N., Cece, V., & Lentillon-Kaestner, V. (2024). The effects of the Jigsaw method on students' physical activity in physical education: The role of student sex and habituation. *European Physical Education Review*, 30(1), 85-104. <https://doi.org/10.1177/1356336X231184347>
- Flemons, M. E., Hill, J., O'Donovan, T., Chater, A. (2024). Recycling and Resistance to Change in Physical Education: The Informal Recruitment of Physical Education Teachers in Schools. *Journal of Teaching in Physical Education*, 43, 21-30 <https://doi.org/10.1123/jtpe.2022-0215>
- Gani, R. A., Setiawan, E., Achmad, I. Z., Aminudin, R., Purbangkara, T., & Hofmeister, M. (2023). Virtual reality-based tabata training: a professional method for changing levels physical fitness and psychological well-being on student-athletes. *Pedagogy of Physical Culture and Sports*, 27(2), 91–101. <https://doi.org/10.15561/26649837.2023.0201>
- Gråstén, A., Wang, J. K. C., Huhtiniemi, M., & Jaakkola, T. (2023). Accelerometer-based physical activity in need satisfaction profiles of schoolchildren: A 3-year follow-up. *European Physical Education Review*, 29(3), 405-420. <https://doi.org/10.1177/1356336X231157331>
- Jiang Qing, Huang Xin, Wang Zuoliang, Dai Xinghong, Li Rongxuan, Cui Di (2023). Regional differences of physical fitness and overweight and obesity prevalence among college students before and after COVID-19 pandemic since the “double first-class” initiative in China. *Frontiers in Public Health*, 11, 1-18. <https://doi.org/10.3389/fpubh.2023.1252270>
- Kaloka, P.T., Nopembri, S., Yudanto, Elumalai, G. (2024). Improvement of Executive Function Through Cognitively Challenging Physical Activity with Nonlinear Pedagogy In Elementary Schools. *Retos*, 51, 673–682
- Kinder, C. J., Richards, K. A., Trad, A. M., Woods, A. M., & Graber, K. C. (2023). Perceived organizational support, marginalization, isolation, emotional exhaustion, and job satisfaction of PETE faculty members. *European Physical Education Review*, 29(4), 475-492. <https://doi.org/10.1177/1356336X231159636>
- Kozin, O., Cretu, M., Boychuk, Y., Kozina, Z., Korobeinik, V., & Sirenko, P. . . (2022). Comparative characteristics of the functional state of future art teachers and other pedagogical specialties students. *Health, Sport, Rehabilitation*, 8(4), 20–31. <https://doi.org/10.34142/HSR.2022.08.04.02>
- Kozin, O., Kozina, Z. ., Cretu, M., Boychuk, Y., Pavlović, R., Garmash, I. ., & Berezhna, Y. (2023a). Vegetative regulation of vascular tone and features of the nervous system of pedagogical universities students. Is there a relationship with professional specialization? *Health, Sport, Rehabilitation*, 9(1), 29–44. <https://doi.org/10.34142/HSR.2023.09.01.03>

- Kozin, O., Kozina, Z., Kozin, V., Korobeinik, V., Panyok, T., Schepelenko, T., & Polishchuk, S. (2023b). Influence of the professional and motor skills integral development method application on physical fitness indicators of Arts Faculty students: a randomized control trial. *Journal of Physical Education and Sport*, 23(6), 1350-1358. doi:10.7752/jpes.2023.06165
- Kozin, V., & Matlaiev, V. (2023). Training basketball players technology of of student teams of the humanitarian profile higher education institutions. *Health Technologies*, 1(4), 31–45. <https://doi.org/10.58962/HT.2023.1.4.31-45>
- Kozina, Z., Garmash, I., & Berezhnaya, Y. (2022). Sport as a factor in the improvement of the stability of the nervous system to the exhaustion and expansion of students' orthostatic reactions. *Health-Saving Technologies, Rehabilitation and Physical Therapy*, 3(1), 75–86. <https://doi.org/10.58962/HSTRPT.2022.3.1.75-86>
- Lobo, J., Peralta, R., Prevandos, F. G., Bautista, C., Agupitan, J., & Maboló, J. G. (2023). The importance of individual interest and school engagement to the advancement of physical culture promotion in schools of higher education. *Health, Sport, Rehabilitation*, 9(3), 24–39. <https://doi.org/10.58962/HSR.2023.9.3.24-39>
- Lu, S., Ding, Y., Liu, M., Yin, Z., Yin, L., & Zheng, W. (2023). Multiscale feature extraction and fusion of image and text in VQA. *International Journal of Computational Intelligence Systems*, 16(1), 54. <https://doi.org/10.1007/s44196-023-00233-6>
- Martos-García, D., Lozano-Sufrategui, L., & Drew, K. J. (2023). 'Once upon a time'. Exploring the possibilities and limitations for inclusive PE through creative writing: A tale of exclusion, integration and inclusion. *European Physical Education Review*, 29(3), 455-471. <https://doi.org/10.1177/1356336X231158583>
- Pavlović, R. (2024). Differences in the indicators of speed and agility of students of the Faculty of physical education of the 3rd year of study in different years of entering the university. *Health, Sport, Rehabilitation*, 10(1), *In press*. Retrieved from <https://hsr-journal.com/index.php/journal/article/view/509>
- Pavlović, R., & Siryi, O. (2023). Football as a means of integral development of intellectual abilities and physical fitness of middle school students. *Health Technologies*, 1(1), 24–29. <https://doi.org/10.58962/HT.2023.1.1.24-29>
- Salvador-García, C., Chiva-Bartoll, O., & Hortigüela-Alcalá, D. (2024). Finding the place of content and language integrated learning in physical education within the models-based practice framework. *European Physical Education Review*, 30(1), 3-18. <https://doi.org/10.1177/1356336X231172488>
- Shao Z, Zhai Q, and Guan X. (2023). *Physical-model-aided data-driven linear power flow model: an approach to address missing training data*, in *IEEE transactions on power systems*, <https://doi.org/10.1109/TPWRS.2023.3256120>.
- Simonton, K. L., Mercier, K., Richards, K. A. R., & Gaudreault, K. L. (2023). The association of perceived mattering and emotions with physical educator teacher resilience. *European Physical Education Review*, 29(4), 582-600. <https://doi.org/10.1177/1356336X231166545>
- Tsyhura, H., & Harkusha, S. (2023). Education for Sustainable Development: Understanding by Physical Education and Sports Specialists. *Physical Education Theory and Methodology*, 23(4), 614–621. <https://doi.org/10.17309/tmfv.2023.4.17>
- Yuniana, R., Tomoliyus, T., Kushartanti, B. W., Nasrulloh, A., Rismayanthi, C., Sulistiyono, S., ... Elumalai, G. (2023). Comparative analysis of the musculoskeletal system disorders and the stress level of sports faculties students in Indonesia and Malaysia. *Health, Sport, Rehabilitation*, 9(2), 22–37. <https://doi.org/10.34142/HSR.2023.09.02.02>
- Zhou, W., Guo, B. & Cao, F. (2023). Hybrid neural network-based exploration on the influence of continuous sensor data for the balancing ability of aerobics students. *Wireless Netw*, 29, 3679–3692. <https://doi.org/10.1007/s11276-023-03431-4>