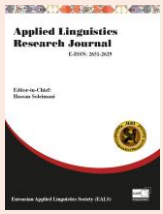

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The Level of Logical Thinking of Female Students who Specialize in Various Sports and its Relation with the Success of Foreign Languages Learning

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ABSTRACT

The article is devoted to the research of the influence of training loads of different orientations on the level of logical thinking of female athletes and its relation with the success of foreign languages learning by them. The research involved 17–20 years old female students (n = 114) who were engaged in various sports during their studies. Two experimental groups were formed: group A (n = 50) consisted of female students who were engaged in speed and strength sports (freestyle wrestling, track and field athletics: sprinting, hurdling, jumping, shot putting and discus throwing); group B (n = 64) was represented by female students who practiced endurance sports (skiing, track and field athletics: 800, 1500, 3000 and 5000 m running; 200, 400 and 1500 m swimming). The control group (group C) consisted of female students who were not engaged in sports (n = 97). The research of logical thinking indicators was carried out according to the method of "Numerical series". We also investigated the results of female students' educational activities of experimental and control groups on the average score in foreign (English) language learning. It was found that there are insignificant changes in the indicators of logical thinking under the influence of physical loads of speed and strength nature, and there is a statistically significant improvement under the influence of loads on endurance. It was also found that the success of mastering the foreign language by the students of the experimental group who practiced endurance sports is better than in the students of the control group but without any significant difference. This shows that the rational combination of sports and learning does not harm the educational process and facilitates the foreign languages learning by female students.

Keywords: Logical Thinking, Female Students, Sports, Education, Foreign Languages.

1. Introduction

It is known from the literary sources that the effectiveness of sports activities, learning success, practical use of work skills and psychophysiological support of professional activities are significantly influenced not only by the properties of basic nervous processes (strength and lability of nervous processes) but also psychodynamic functions of a human body (Afrouzeh, Musa, Suppiah, & Abdullah, 2020; Chernenko et al., 2020; Griban et al., 2019; Korobeynikov et al., 2019; Prontenko et al., 2019c; Tymoshenko et al., 2019). The research results by a number of authors (Griban et al., 2020; Halian et al., 2020; Khoroshukha et al., 2019a; Kovalenko et al., 2020; Kryshtanovych, Bilostotska, Ulianova, Tkachova, Tkachov, 2020; Paliichuk et al., 2018; Prontenko et al., 2019b) testify that effective performance of continuous and sufficiently intense physical, mental and intellectual loads that require maximum concentration of attention, prompt thinking and quick decision-making in conditions of physical fatigue, requires not only physical fitness, an appropriate level of development of sports skills but also a high level of such mental properties as attention, perception of time, visual memory and logical thinking.

There are also many scientific papers in which researchers point to the positive effects of motor performance and sports on the development of mental functions (including logical thinking), which, in turn, contribute to the high development of mental and creative abilities of pupils and students. Thus, R. Ghildiyal (2015) points to the possibility of forming the character and leadership qualities in athletes under the influence of sports and the development of the properties of logical thinking. S. R. Tortolero, W. C. Taylor and N. G. Murray (2000) and R. J. Shephard (1997) conclude on the basis of their long-term researches that regular exercises and sports have a positive effect on the mental processes of young people. In particular, according to R. J. Shephardthe (1997) latter is stipulated by an increase in students' cerebral circulation, positive hormonal changes in the body, as well as improving the constitution. The results of research by B. W. Tuckman and J. S. Hinkle (1986) reveal that aerobic training (for example, field-and-track running) has a beneficial effect on the activities of the right hemisphere of the brain of children thereby stimulating their creative abilities. Thus, it can be assumed that logical thinking, like attention, perception and memory, is an active process, and therefore can change under the influence of physical training (Manolachi, & Vizitei, 2018; Prontenko et al., 2020a; Prysiazhniuk et al., 2019; Shkola et al., 2019). Our previous psychophysiological studies of logical thinking in young athletes of specialized sports institutions of Ukraine can evidence this. The generalizing conclusion of these works is the establishment of the fact concerning the specificity of the influence of training loads of different orientations on the logical thinking of teenage and adolescent athletes (Khoroshukha et al., 2019b; Khoroshukha et al., 2019c). However, the problem of studying the influence of training loads of different orientations on the level of logical thinking of female athletes and the success of foreign language learning by female students remains practically unresearched. The study of this problem will expand the theoretical arsenal of knowledge to address a number of practical issues, such as issues related to the impact of exercise of different nature on the mental abilities of young people in terms of optimizing their learning and training sessions in order to ensure effective mental and physical activities, the conduct of psychophysiological sports selection, etc.

2. Methodology

The research investigates the influence of training loads of different orientations on the level of logical thinking of female students and its relation with the success of foreign languages learning.

Research methods: theoretical analysis and generalization of scientific and methodical literature, pedagogical observation, testing, methods of mathematical statistics.

The research involved 17-20 years old female students (n = 114) of Brovary Higher Specialized School of Physical Culture (Kyiv oblast, Ukraine) who were engaged in various sports during their studies. Two experimental groups were formed: group A (n = 50) consisted of female students who, according to the classification of sports by A. H. Dembo (1980), were engaged in speed and strength sports (freestyle wrestling, track and field athletics: sprinting, hurdling, jumping, shot putting and discus throwing); group B (n = 64) was represented by female students who practiced endurance sports (skiing, track and field athletics: 800, 1500, 3000 and 5000 m running; 200, 400 and 1500 m swimming). The control group (group C) consisted of female students of the same age who were not engaged in sports at the Faculty of Physical Education and Sports of M. P. Drahomanov National Pedagogical University (n = 54) and the Faculty of Health, Physical Education and Sports of Borys Hrinchenko Kyiv University (n = 43). The research was conducted in 2019 (Stage I) and 2020 (Stage II) during the 1st and 2nd year of female students' education.

The research of logical thinking indicators was carried out according to the method of the "Numerical series" proposed by M. V. Makarenko (1987).

Each female Student was given forms with missing numbers in rows (total number of spaces – 10). The female students had to choose the right numbers that should complement a series of previously presented numbers. The time limitation for the task is 10 minutes. In case of performance of tasks earlier than the allotted time, time of direct performance of work was

registered. Four types of forms were used according to the method of "Numerical series". Two of them (Type 1 and Type 2), as an example, are given in Table 1.

Table 1. *Typical variants of assessing of the female students' logical thinking by the methodology "Numerical series"*

Variant-1
27 24 22 21 18 16 - -
1 4 - 16 25 - 49 64 81 100
17 19 21 20 22 24 - -
2 3 6 7 14 15 30 - -
8 12 4 6 8 7 24 27 3 36 64 49 12 - 7 48 80 -

Variant-2									
	15	17	20	19	21	24	-	-	
1	-	-	16	25	36	49	64	81	100
	16	15	17	14	18	13	-	-	
	3	5	10	12	24	26	-	-	
	7	-	9			3	5	4	
	8	23	15			9	25	16	
	9	21	12			15	35	-	

The quantitative indicators for assessing the female students' logical thinking included the following ones: the number of correct answers, the number of errors during the work; the speed of thinking; the general assessment of the state of logical thinking (in points). The speed of thinking was determined by the ratio of the number of correct answers to the performance time. The general assessment of the female students' logical thinking was carried out according to the following Table 2.

Table 2. *The general assessment of the female students' logical thinking*

Assessment, points	6	5	4	3	2	1	0
Correct answers, quantity	10	9	8	7	6	4-5	1-3

Assessment of the results of the research of logical thinking was carried out according to the comparative analysis of the first and second (a year later) stages of the survey according to the following scheme: 1) separately for each sport, 2) separately for groups of female athletes according to sports classification, 3) carrying out the comparative analysis of indicators of the experimental groups with the control group.

The testing was performed in the office of psychophysiological monitoring in the morning (from 9 to 12 a.m., not earlier than 2 hours after a meal). One or two days before the examination, female students were asked to reduce physical loads by volume and intensity by 50%, not to take tonics and sedatives, and on the day of testing – strong tea or coffee.

Also, we investigated the results of female students' educational activities of experimental and control groups on the average score in the English language learning to research the relationship between the level of development of logical thinking of female students and the effectiveness of foreign languages learning by them.

The mathematical statistics methods were applied to correctly process the data and identify the difference between the studied indicators. The results were reported as $X \pm m$. The significance of the difference between the indicators was determined with the help of the Student's t-test. The statistical significance for all statistical tests was set at $p<0.05$. All statistical analyses were performed with the SPSS software, version 21, adapted to medical and biological researches.

Each female Student participated in the study on a voluntary basis. In the process of conducting the research, we followed the directives of the European Society No. 86/609 and the legislation of the Helsinki Declaration of 2013 on human participation in biomedical research. All individuals were healthy at the time of the examination.

3. Results

The analysis of indicators of logical thinking in female athletes, who mainly develop speed and strength qualities (female wrestlers, athletes) (Table 3), reveals the insignificant nature of changes in the number of errors and speed of thinking according to repeated (after a year) surveys ($p > 0.05$). As a result, no significant differences were found in the nature of changes in the integrated indicator, i. e. the total score (in points) of the mentioned function ($p > 0.05$).

Table 3. *Indicators of logical thinking of female students of speed and strength sports (group A) according to the first (I) and second (II) stages of the research (n = 50), X ± m*

Indicators	I	II	t	p
Female wrestlers				
The number of students	(n=23)	(n=23)		
The number of errors, units	6.4±0.61	6.1±0.52	0.37	>0.05
The speed of thinking, c. u.	0.4±0.04	0.4±0.03	0.00	>0.05
The state of logical thinking, points	0.9±0.55	0.9±0.46	0.00	>0.05
Female athletes				
The number of students	(n=27)	(n=27)		
The number of errors, units	6.1±0.57	6.0±0.49	0.13	>0.05
The speed of thinking, c. u.	0.4±0.03	0.4±0.02	0.00	>0.05
The state of logical thinking, points	0.9±0.51	1.0±0.44	0.15	>0.05

The female students who practiced endurance sports (Table 4) (female athletes, skiers, swimmers) also showed insignificant changes in logical indicators ($p > 0.05$), but the tendency to improve their dynamics was clearly observed. It is important to note that female swimmers, who also represent this group of sportswomen, in contrast to other sports, revealed a statistically significant improvement in logical thinking indicators ($p < 0.01$).

Table 4. *Indicators of logical thinking of female students of endurance sports (group B) according to the first (I) and second (II) stages of the research (n = 64), X ± m*

Indicators	I	II	t	p
Female athletes				
The number of students	(n=23)	(n=23)		
The number of errors, units	4.2±0.30	3.5±0.24	1.82	>0.05
The speed of thinking, c. u.	0.6±0.06	0.7±0.06	1.18	>0.05
The state of logical thinking, points	1.9±0.27	2.2±0.18	0.92	>0.05
Female skiers				
The number of students	(n=19)	(n=19)		
The number of errors, units	4.1±0.27	3.6±0.23	1.41	>0.05
The speed of thinking, c. u.	0.6±0.06	0.7±0.06	1.18	>0.05
The state of logical thinking, points	2.0±0.26	2.2±0.18	0.63	>0.05
Female swimmers				
The number of students	(n=22)	(n=22)		
The number of errors, units	2.8±0.29	1.5±0.24	3.45	<0.01
The speed of thinking, c. u.	0.7±0.03	0.9±0.05	3.43	<0.01
The state of logical thinking points	3.1±0.26	4.3±0.20	3.65	<0.01

The female students of the control group who are not engaged in sports (Table 5) showed unreliable ($p > 0.05$) nature of changes in the number of errors, speed of thinking and the general level of logical thinking both according to the first and second stages of the research.

Table 5. *Indicators of logical thinking of female students who are not engaged in sports (group C) according to the first (I) and second (II) stages of the research (n = 97), X ± m*

Indicators	I	II	t	p
The number of students	(n=97)	(n=97)		
The number of errors, units	4.0±0.45	3.9±0.41	0.16	>0.05
The speed of thinking, c. u.	0.6±0.05	0.6±0.05	0.05	>0.05
The state of logical thinking, points	2.0±0.37	2.0±0.36	0.00	>0.05

Table 6 provides the analysis of changes in logical thinking indicators separately for two groups of sportswomen: group A consisting of sportswomen of speed and strength sports and group B represented by sportswomen of endurance sports. The female students of group A showed insignificant differences in the values of indicators of the number of errors, speed of thinking and general assessment of logical thinking ($p > 0.05$). The sportswomen in group B revealed a statistically significant improvement in all three indicators of logical thinking (decrease in the number of errors, increase in average values of thinking speed and, accordingly, improvement of the

overall assessment of the level of logical thinking) ($p < 0.05$ in all cases).

Table 6. *Indicators of logical thinking of female students of speed and strength sports (group A) and endurance sports (group B) according to the first (I) and second (II) stages of the research (n = 114), X ± m*

Indicators	I	II	t	p
Experimental group A				
The number of students	(n=50)	(n=48)		
The number of errors, units	6.3±0.59	6.1±0.50	0.26	>0.05
The speed of thinking, c. u.	0.4±0.03	0.4±0.02	0.00	>0.05
The state of logical thinking, points	0.9±0.53	1.0±0.45	0.14	>0.05
Experimental group B				
The number of students	(n=64)	(n=63)		
The number of errors, units	3.7±0.28	2.9±0.23	2.21	<0.05
The speed of thinking, c. u.	0.6±0.05	0.8±0.06	2.56	<0.05
The state of logical thinking, points	2.3±0.22	2.9±0.19	2.06	<0.05

The following three Tables (Tables 7, 8, 9) provide a comparative analysis of the indicators of logical thinking of three groups of subjects of interest: two groups of female athletes and one group of female students who were not engaged in sports. As it can be seen from Table 7, the sportswomen of endurance sports (group B) showed a statistically significant decrease in the number of errors made during activities compared to their contemporaries, i. e. sportswomen of group A (both according to the first and second stages of the research; $p < 0.001$) and female students who were not engaged in sports (group C), respectively, – only according to the second stage of the research ($p < 0.05$). Paradoxically, but it is the fact that female students, according to the first and second stages of the research who were not engaged in sports, made a significantly smaller number of errors than female students – representatives of speed and strength sports ($p < 0.01$).

Table 7. *The comparative analysis of the changes in the number of errors made by the female students engaged in speed and power sports (group A), endurance sports (group B), and the female students-non-athletes (group C), according to the first (I) and second (II) stages of the research (n=211), units*

Stages	Group A [1] (n=50)	Group B [2] (n=64)	Group C [3] (n=97)	t; [p1–p2]	t; [p1–p3]	t; [p2–p3]
I	6.3±0.59	3.7±0.28	4.0±0.45	3.98; <0.001	3.10; <0.01	0.57; >0.05
II	6.1±0.50	2.9±0.23	3.9±0.41	5.82; <0.001	3.40; <0.01	2.13; <0.05

The comparative analysis of the speed of thinking of the three groups of subjects of interest is given in Table 8. It can be seen from the data in this table that the best average values of speed of thinking were observed in girls of endurance sports than in girls of speed and strength sports both according to the first ($p < 0.01$) and the second stages of the research ($p < 0.001$) and, as expected, – the students of the control group (according to only the second stage of the research; $p < 0.05$). Paradoxically, there was a statistically significant improvement in the speed of thinking (according to both stages of the research) in non-sportswomen students (group C) compared with the sportswomen in group A ($p < 0.01$-0.001).

Table 8. *The comparative analysis of the changes in the speed of thinking of the female students engaged in speed and power sports (group A), endurance sports (group B), and the female students-non-athletes (group C), according to the first (I) and second (II) stages of the research (n=211), units*

Stages	Group A [1] (n=50)	Group B [2] (n=64)	Group C [3] (n=97)	t; [p1–p2]	t; [p1–p3]	t; [p2–p3]
I	0.4±0.03	0.6±0.05	0.6±0.05	3.43; <0.01	3.43; <0.01	0.00; >0.05
II	0.4±0.02	0.8±0.06	0.6±0.05	6.33; <0.001	3.72; <0.001	2.56; <0.05

Accordingly, the average values of the level of logical thinking of the experimental and control groups are given in Table 9. Summarizing the results of the research presented in this table, we can note the following: 1) the level of logical thinking is significantly better (according to both stages of the survey) in the sportswomen of group B than in the sportswomen of group A ($p < 0.05$-0.001) and the female students who were not engaged in sports ($p < 0.05$ according to the data of the second stage); 2) no statistically significant differences were found (according to the first and second stages of the research) between sportswomen who mainly developed speed and strength qualities (group A) and their contemporaries – the girls who were not engaged in sports ($p > 0.05$).

Table 9. *The comparative analysis of the changes in the level of logical thinking of the female students engaged in speed and power sports (group A), endurance sports (group B), and the female students-non-athletes (group C), according to the first (I) and second (II) stages of the research (n=211), units*

Stages	Group A [1] (n=50)	Group B [2] (n=64)	Group C [3] (n=97)	t; [p1–p2]	t; [p1–p3]	t; [p2–p3]
I	0.9±0.53	2.3±0.22	2.0±0.37	2.44; <0.05	1.70; >0.05	0.70; >0.05
II	1.0±0.45	2.9±0.19	2.0±0.36	3.89; <0.001	1.74; >0.05	2.21; <0.05

The analysis of the results of the English language learning by the students of experimental and control groups during the 1st and 2nd years of education showed that the highest values of success in the first and second stages of the study were found in female students who practiced endurance sports, and the worst – in female students who were engaged in speed and strength sports (Table 10). However, no significant difference was found between all the studied groups of female students, both in the first and in the second stages of the research ($p > 0.05$).

Table 10. *Comparative analysis of the success of a foreign language learning in sportswomen students of speed sports (group A), endurance sports (group B) and female students who were not engaged in sports (group C), according to the first (I) and second (II) stages of the research (n = 211), points*

Stages	Group A [1] (n=50)	Group B [2] (n=64)	Group C [3] (n=97)	Significance of the difference		
				t; [p1–p2]	t; [p1–p3]	t; [p2–p3]
I	3.42±0.16	3.63±0.17	3.57±0.14	0.90; >0.05	0.71; >0.05	0.27; >0.05
II	3.99±0.15	4.09±0.15	4.05±0.12	0.42; >0.05	0.26; >0.05	0.21; >0.05

The level of English language proficiency in female students of all three groups significantly improved ($p < 0.05$) in the process of learning. This suggests that the rational combination of sports (especially sports for endurance) and learning does not harm the educational process but also facilitates foreign languages learning by female students.

4. Discussion

The comparative analysis of the average values of the development of logical thinking in three groups of female students showed that despite the fact that the function of logical thinking like other mental functions (attention, perception, memory) is characterized by pronounced genetic heredity and, according to physiologist J. Hoffman (2014) is poorly subject to correction by means of physical education. We believe that the direction of the training process specifically specializes the peculiarities of logical thinking development. The evidence base of the above may be the following: no significant differences in the number of errors made by the athletes, their speed of thinking and level of logical thinking ($p > 0.05$) were revealed in the girls of speed and strength sports (freestyle wrestling, track and field athletics: sprinting, hurdling, jumping, shot putting and discus throwing); the female athletes who mainly developed endurance (skiing, track and field athletics: 800, 1500, 3000 and 5000 m running) also did not show any significant differences in the average values of the above indicators, although there was a tendency to improve their dynamics; whereas female swimmers (distance: 200, 400 and 1500 m) showed a statistically significant decrease in the number of errors and, accordingly, an increase in thinking speed and in the overall level of logical thinking according to both the first and second stages of the research ($p < 0.01$). According to our previous research, the highest level of logical thinking development was also found in adolescent and teenage swimmers (Khoroshukha et al., 2021). Therefore, we can assume that swimming has a positive effect on the development of logical thinking to a greater extent than other sports. Proof of this is the following: 1) it is known from the physiology of sport that during swimming, the athlete is mainly in a horizontal position, which stimulates blood flow to the head and thus enhances the activity of both hemispheres of the brain. According to the scientists (Brown, 2001), much consideration is paid to swimming in the training process of chess players, who are a priori characterized by a high level of logical thinking development. From the research of R. S. Weinberg & D. Gould (2018), we find that the speed of simple and complex reflex motor reactions (as practice shows, the latter play an important role in achieving high sports results) was significantly higher in swimmers than in representatives of other sports (including track and field athletics, wrestling, competitive sports). The fact that female students with different orientation of the training process on most indicators had the same nature of their changes yet again is indisputable evidence of the specific impact of training loads of different orientation on the body functions of people of different ages, genders and occupations (Makarenko, & Lyzohub, 2007; Korobeynikov et al., 2020). No significant differences were found in the nature of changes in all logical thinking indicators ($p > 0.05$) in the female students who were not engaged in sports.

In general, the results of our research on the impact of training loads of different orientations on the development of the function of logical thinking of 17-20 years old female students and the previously conducted

similar studies involving male students of the same age have not only theoretical but also practical interest. The practical significance of the work is to solve the problem of optimizing educational and training sessions in the educational process in order to ensure effective mental and physical activities. In our opinion, when planning physical education classes during the day, it is necessary to take into account the fact of the specific influence of training loads of different nature on the development of logical thinking in order to increase the cognitive activities of students. Thus, we found that the best knowledge of the English language was shown by female students who specialized in endurance sports as the result of the study of the relationship between the level of logical thinking of female students who were engaged in different sports and the success of foreign language learning. Although there is no significant difference between female students' performances in all three groups under investigation, it is worth noting the positive impact of sports on endurance, both on the development of logical thinking of female students and the level of foreign (English) language learning. The results obtained complement and extend the findings of many studies (Prontenko, Bublei, Marushchak, & Bondar, 2020; Kononenko et al., 2020; Prontenko et al., 2019a; Prontenko et al., 2020c).

5. Conclusions

Analyzing the nature of changes in the indicators of logical thinking in female students of three groups, we come to the conclusion that the direction of the training process specializes the development of logical thinking. Under the influence of training loads, which are mainly aimed at developing endurance, the indicators of logical thinking in female students significantly improved (number of errors, speed of thinking, and general level of logical thinking). Female students who are not engaged in sports, according to some indicators, show an improvement in logical thinking compared to sportswomen who participate in speed and strength sports.

It was found that the success of mastering a foreign (English) language by female students who were engaged in endurance sports is better than by female students who did speed and strength sports and female students who were not engaged in sports. Still, no significant difference was found between them. This shows that endurance sports are most effective in improving language learning. Thus, the rational combination of sports (especially aimed at developing endurance) and learning does not harm the educational process but also facilitates the foreign languages learning by female students.

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Competing Interests

The authors declare that they have no conflict of interests.

Transparency

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study that was reported, that no vital features of the study have been omitted, and that any discrepancies from the study as planned have been explained.

Ethical

This study follows all ethical practices during writing.

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