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Original Article

Peculiar features between the studied indicators of the dynamic and interconnections of mental workability of students

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Abstract:
The purpose of the work: study of students' mental workability with the help of different methodic and comparative analysis of the received results. *Material:* 40 students of 22–23 years' age (30 boys and 10 girls) participated in the research. We used battery of tests, which included Anfimov's tables, tapping test and audit tables by Kreppeling. *Results:* results of correcting test reflected stable state of mental workability in interval Monday-Wednesday with gradual decrease in the second half of week. Some links of functional system worked by different mechanisms (growth, stability, reduction). Against the background of low initial level of system's work it was assessed as formation of pre-nosological state. *Conclusions:* results of all tests shall be assessed as reflection of fatigue's gradual formation. Mental workability state is and indicators of functional state. It reflects imbalanced condition of regulatory mechanisms, characteristic for pre-nosological state.
Key words: sportsmen, mental workability, progress in study, mental fatigue.

Introduction

Training of modern specialists stipulates increase of training process quality and effectiveness in higher educational establishments. In a number of works importance of future specialists' mental workability for professional success is noted. An important component of mental workability is study of its characteristics and their correction in case of any problem (Ahmadi, Abdollahi, Ramezani, & Heshmati, 2010; Priscilla, Ellie, & Linsey, 2015; Bliznevsky et al., 2016).

A compulsory condition of training process's effectiveness is students' high functional level. This conception means sufficient mental and physical workability. It relates to criteria of health condition and depends on many of external and internal factors. Disorders of functional state result in pre-nosological states, which noticeably weaken workability (Podrigalo & Danylenko, 2014). Connections between physical and mental fatigue is proved in a number of works (Prysjazhnuk, 2012; Masaaki, Akira, & Yasuyoshi, 2016; Pomeshchikova et al., 2016). It is noted that the most effective factors of fatigue's influence and rising of students' workability is usage of active rest minor forms during working day (Prysjazhnuk, 2012) or everyday motor functioning (Lupu, 2015; Furley & Wood, 2016). Close correlation between mental workability and physical condition indicators of students was determined in some works (Byshevets, 2012; Tishchenko, 2012). In such cases substantiation of adequacy of the used tests acquires special importance (Ivashchenko & Yermakova, 2015a, 2015b; Kozina, Repko, Ionova, Boychuk, & Korobeinik, 2016).

In other researches it is noted the need in the following: application of visual trainings at physical education classes for improvement of visual analyzer's workability and minimization of negative learning loads on eyes' accommodative functions of students (Bondarenko, Darzinska, & Sidilo, 2015); application of physical culture – health related trainings in increase of girl students' physical and mental workability (Petrenko, 2013; Buszard et al 2016); support of students' physical and psychic health in conditions of high educational load, which facilitates increase of workability and better progress (Vasile, 2012; Alloway, Bibile, & Lau, 2013; Kurata, Bano, & Matias, 2015). All these, taken together, influence on specialists' future functioning in sphere of physical culture and sports (Furley et al., 2016).

In our previous works we found that intensification of educational activity requires mastering higher scope of information. It substantially increase load on organism. Besides, non uniform distribution of load in period of learning conditions relevance of problem of students' fatigue diagnostic and over-fatigue prophylaxis. Active youth's learning and cognitive functioning takes place in conditions of objective contradictions: between need in mastering significant volume of information and time deficit; between gradual, many years process of future specialist's formation and wish for self-realization as quick as possible; between need to study and impossibility to restrict himself only by learning. These contradictions result in workability weakening; in

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decrease of stress-resistance; in strengthening of adaptation tension. All these result in formation pre-nosological disorders of youth's (Podrigalo & Danylenko, 2014). In such cases important role is played by the following:

– Strengthening of students' psycho-physical state and psycho-social health at physical culture academic and recreational classes (Dzierzanowski et al., 2013; Kopylov et al., 2015; Skurikhina, Kudryavtsev, Kuzmin, & Iermakov, 2016);

– Regulation of students' motor functioning, considering their motivation for success or for avoiding failures (Iermakov, Cieślicka, & Muszkieta, 2015; Kozina & Iermakov 2015; Eksterowicz, Napierała, Żukow, 2016);

– Increase of students' interest in development of physical qualities, which are decisively important for future professional activity (Iermakov, Ivashchenko, & Guzov, 2012; Kuzmin, Kopylov, Kudryavtsev, Galimov, & Iermakov, 2015; Pryimakov, Iermakov, Kolenkov, Samokish, & Juchno, 2016);

– Application of innovative technologies for practical tasks solution by girl students – sportswomen (Sobko et al., 2014; Nosko, Razumeyko, Iermakov, & Yermakova, 2016);

– Application of reasonable tests for motor functioning (Ivashchenko et al., 2016; Korobeynikov, Korobeynikova, Iermakov, & Nosko, 2016; Kuzmin et al., 2016).

The existing situation shows that it is important to study mental workability specificities in the process of students' learning at universities.

The purpose of the work is to study students' mental workability with the help of different methodic and comparative analysis of the received results.

Material and methods

Participants

In the research 40 undergraduate students of 22-23 years' age (30 boys and 10 girls) of pedagogic university physical culture faculty participated. The research was conducted in compliance with WMA Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects, 2013.

The design of the research implied study of mental workability with the help of Anfimov's correction test, Kreppeling's audit table and tapping test. The researches were realized in dynamic of day (1st and 3rd pairs of lessons) and week (Monday-Wednesday-Friday) time cycles. The mentioned methodic was aligned with generally accepted instructions (Makarenko, 1996). For fulfillment of Anfimov's test the participant got correction table and looked through horizontal lines as quick as possible during 5 minutes, underlining or deleting two pre-set letters. The volume of works and absolute quantity of mistakes per 500 signs were assessed (see table 1).

Table 1. Assessment of mental workability indicators by Anfimov's table

Assessment of indicators	Quantity of signs, looked through during 5 minutes	Quantity of mistakes, made for 5 minutes
Excellent	1000 and more	2 and less
Good	800–999	3–5
Satisfactory	700–799	6–10
Unsatisfactory	699 and less	11 and more

On the base of these data we calculated indicators of accuracy and efficiency of mental work. Indicators of work accuracy (T, conv. un.) was calculated by the following formula: $T = M/n$,

where M – total quantity of underlined or deleted signs, n – quantity of signs, which shall be marked out in the looked through test.

Efficiency coefficient (E, sg. – reflects quantity of correctly understood signs, from all looked through) was calculated by formula: $E = N \cdot T$,

where N – total quantity of the looked through signs, T – accuracy of work.

Tapping test permits to assess typological properties of nervous activity – lability and the strength of nervous processes. The task was to quickly mark points in four squares 5x5 cm turn by turn, spending 10 second for every square. In analysis we counted the quantity of points in every square separately and their total sum. Conclusion about sensor- motor analyzer's lability is made basing on total sum of points (see table 2). Maximal frequency of tapping is indicator of activity's ergic component.

Table 2. Assessment of nervous system's lability

Quantitative parameters	Levels of development
220 and less	Low
221–264	Average
265 and more	High

In taping test nervous system's strength manifests in ability of the tested to keep up the pace of work at certain level. The less difference between initial and final indicators is the stronger nervous system is. For quantitative determination of strength/weakness we offer indicator of endurance. This indicator is calculated as correlation of points' quantity in the last 10 seconds to the points' quantity in the first 10 seconds. Results are assessed by scale, given in table 3.

Table 3. Assessment of nervous system's strength by tapping test

Quantitative parameters	Assessment of nervous system's strength-weakness
0.81 and less	Average and average-weak
0.82–0.92	Average
0.93 and more	Average strong and strong

By results of tapping test fulfilled by two hands we can judge about brain hemispheres' functional lateralization. For this purpose functional asymmetry coefficient is calculated for workability of right and left hands by the following formula:

$KFa = [(\Sigma R - \Sigma L)/(\Sigma R + \Sigma L)] \cdot 100\%$,

where, ΣR – sum of right hand points; ΣL – sum of left hand points.

Assessment of workability by Kreppeling's tables requires summing up pairs of figures as quick as possible. If sum is higher than 10 then "ten" is neglected and only figures less than 10 are written. The test is fulfilled during 2 minutes. Test results are assessed by total quantity of summed up pairs of figures and quantity of mistakes. Total indicators show general assessment of workability and the setting of the participant for quickness and accuracy of work. Success of material's mastering was assessed by percentage of correct answers to 60 tests. The testing was conducted in Friday at the end of day. Time for test fulfillment was 60 minutes.

Statistical analysis of the received data was fulfilled with the help of licensed packages of Excel (2010) tables. We determined indicators of descriptive statistic (mean arithmetic, standard deviation and error of mean value) (Antomonov, 2006). Confidence of differences between values was assessed by Student's criterion and criterion of signs; difference was considered confident at $p<0.05$. For determination of indicators' correlation we calculated correlation coefficients by Pearson and constructed correlation structures (Antomonov, 2006).

The informed consent was obtained from study participants.

Results

Analysis of students' mental workability indicators is given in table 4.

Table 4. Indicators of students' mental workability in day and week dynamic as per realized methodic

Indicators	Monday 1st academic pair	Monday 3rd academic pair	Wednesday 1st academic pair	Wednesday 3rd academic pair	Friday 1st academic pair	Friday 3rd academic pair
Volume of work (quantity of signs)	428.6±16.3	443.3±28.9	450.8±21.3	476.7±31.3	357.1±16.0[1]	368.2±18.0[1]
Quantity of mistakes, absolute	6.3±0.3	4.9±0.3[3]	9.1±0.7[1]	7.5±0.5[1,3]	2.4±0.1[2]	3.9±0.2[1,3]
Accuracy in 100 signs	0.90±0.02	0.92±0.02	0.85±0.03[1]	0.89±0.02[1]	0.96±0.01[1]	0.92±0.01[3]
Efficiency	386.9±19.3	409.3±31.4	387.4±27.2	426.7±34.2	343.4±13.9[1]	338.6±13.3[1]
Nervous system's lability (right hand)	230.6±8.0	240.2±9.0	245.5±10.6	245.8±9.0	221.9±13.7	219.9±10.0[1]
Nervous system's strength (right hand)	0.86±0.02	0.86±0.02	0.85±0.01	0.85±0.01	0.96±0.03[1]	0.92±0.03[1]
Nervous system's lability (right hand)	205.1±7.6	205.8±8.7	213.5±7.7	213.4±8.6	187.1±12.0	177.5±10.5[1]
Nervous system's strength (right hand)	0.83±0.01	0.84±0.01	0.89±0.02[1]	0.89±0.02[1]	0.98±0.03[1]	0.92±0.02[1,3]
Asymmetry coefficient	0.89±0.02	0.89±0.02	0.90±0.03	0.91±0.03	0.78±0.01[1]	0.79±0.01[1]
Pairs of figures, absolute	105.2±6.8	84.8±11.8	97.5±8.5	82.8±9.5	105.1±7.7	95.2±4.8
Mistakes, absolute^{-1}	0.14±0.01	1.10±0.06[3]	1.12±0.04[1]	1.23±0.05[3]	0.33±0.01[1]	1.30±0.01[2,3]

Notes: 1 – differences in week dynamic are confident at ($p<0.05$); 2 – differences in week dynamic are confident at ($p<0.005$); 3 – differences in day dynamic are confident at ($p<0.05$).

The scope of work in correction test was characterized by low indicators. In the first half of week there were no significant shifts of this indicator. By the end of the week there was substantial reduction of work volume. During day there were also no significant shifts in the looked through signs.

The quantity of mistakes in 500 signs varied significantly during week For example, in Monday workability was satisfactory; in Wednesday – unsatisfactory and in Friday – good. The changes of mistakes' quantity were more expressed in comparison with the scope of work. In week cycle we found the following: increase of relative quantity of mistakes in Wednesday, comparing with Monday; reduction of such mistakes in

Friday. During day (Monday and Wednesday) the quantity of mistakes decreased. In Friday the quantity of mistakes significantly increased. In our opinion it can be explained as fatigue's accumulation by the end of week cycle. Indicator of accuracy also changed during week. We registered its significant improvement in Wednesday and worsening in Friday, comparing with the beginning of the week. Besides, at the end of the week (during day) we registered improvement of accuracy indicator. Efficiency indicator combines qualitative and quantitative components of fulfilled dozed work. It was characterized by sufficient stability in first half of week. By the end of the week we found significant reduction of this criterion. Individual analysis of workability curves during week showed that (60.30±0.02) % of students had reducing type, студентов, (33.30±4.70) % - ascending and (6.40±2.50) % - stable type of workability. Prevalence of students with negative changes of workability quantity ($p<0.05$) witnesses about mental fatigue formation in most of students during week.

Main task of tapping test was determination of nervous system's lability and strength. Lability is determined by quantity of stimuli, to which nervous system is able to respond per unit of time. The second indicator shows workability under maximal load. In the used by us methodic it is an ability to keep maximal race of work within pre-set time. The less is the difference between initial and final indicators the stronger and with higher endurance is nervous system (Makarenko, 1996). Results of right hand (see table 4) witness about average lability level at the beginning of week and low indicators at the end. Left hand lability was low during all period of observation. We found that substantial reduction of lability of both hands by the end of week.

Nervous system's strength (by tapping test) mainly related to average level, except beginning of day on Friday. This indicator related to average-strong and strong interval. Results of symmetry coefficient illustrate stability of this indicator in the middle of week and reduction by the end of week. In our opinion it reflects change changes of mental workability with Wednesday as the day of maximal workability. Increase of indicators' asymmetry shall be assessed as indirect evidence of fatigue progressing and of increase of pre-nosology formation's probability. Results of workability's assessment by Kreppleing witness about stability of the fulfilled dozed work volume. At the same time dynamic of accuracy indicators was more expressed. The quantity of mistakes substantially increased in all days of research. Also attracts attention the fact that at the end of day (Friday) it was maximal. We proved increase of mistakes' quantity in Wednesday and reduction in the morning, on Friday. Correlation analysis of mental workability indicators showed the presence of interconnections between them (see fig.1).

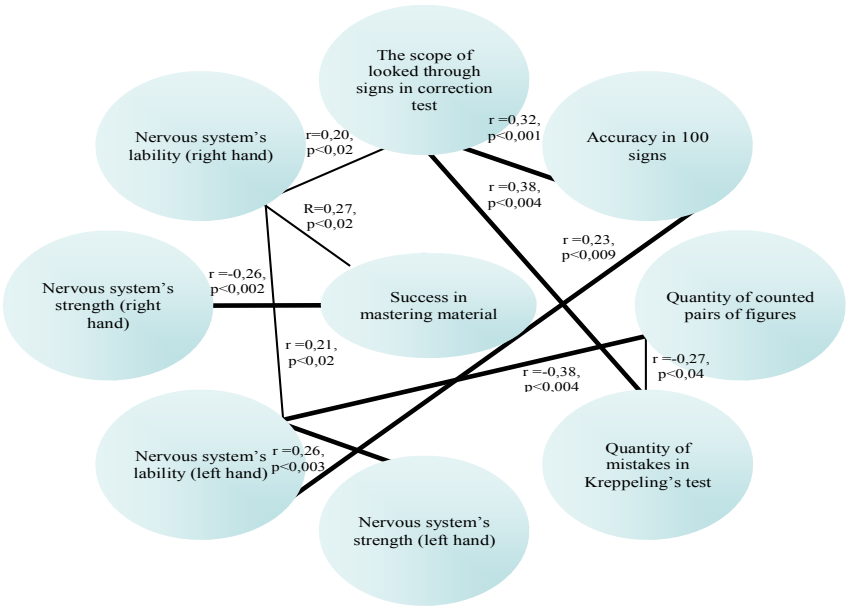

Fig.1. Diagram of correlations between workability indicators and progress in learning

Maximal quantity of confident connections in system is four. It was found that for lability of nervous system, assessed by fulfillment of tapping test by left hand. In Kreppeling's test it was connected with nervous system's strength by left hand and lability by right hand; by accuracy of correction test and quantity of counted pairs. Every three confident correlations had volume of correction test's signs and lability, assessed by right hand. The first criterion correlated with quantity of mistakes in Kreppeling's test, right hand lability and accuracy of correction test. Right hand lability (except volume) was connected with progress in material's mastering and left hand lability. Correction test accuracy had two confident correlations: between progress in material's mastering, quantity of counted pairs and quantity of mistakes in Kreppeling's test. One confident correlation had indicators of nervous system's strength, assessed by tapping test.

Discussion

The received results permit to say that it is necessary to complexly study workability. Application of different functional tests permitted to increase informative potential of the received results to determine

correlations between them. The same results were obtained in the works, devoted to study of martial arts sportsmen's functional state (Bliznevsky, Kudryavtsev, Iermakov, & Jagiełło, 2016; Iermakov et al., 2016; Iermakov, Podrigalo, & Jagiełło, 2016) and synchronous swimmers (Rovnaya, Podrigalo, Aghyppo, Cieślicka, & Stankiewicz, 2016).

Analysis of correction tests' week dynamic witnesses about negative dynamic of quantitative and positive dynamic of qualitative indicators. Efficiency indicator also had negative tendency by the end of week. It can witness about formation of mental fatigue. Misalignment of indicators and their multidirectional changes illustrate instability of this functional system's work.

The received data to large extent coincide with results of Gumenniy V. (2011). The author studied influence of physical education on students' mental workability and psycho-emotional stability depending on specificity of future professional functioning with the help of Anfimov's correction test. He determined positive influence of physical education trainings on mental workability. In other work characteristics of mental workability of technical natural and humanitarian specialties' students were studied (Korobeynikov, Petrov, & Ulizko, 2010). The authors analyzed the following indicators: perception, attention, memory, thinking and mental workability. On the base of their work we can conclude that formation of psycho-physiological organization of different specialties students' information processing system occurs in heterochronic way, depending on orientation of special training. Reduction of points quantity from square to square in tapping test witnesses about insufficient functional stability of nervous muscular apparatus and increasing fatigue. By the end of week the strength of nervous processes increased with simultaneous tendency to lability reduction. In week dynamic in students (in tapping test) nervous system's lability had tendency to reduction, while strength increased. The received data can be explained by the presence of protective inhibition: decrease of nervous system's ability to quickly analyze information. That is why increase of lability and endurance is possible at slow race of work. Students with high lability of nervous system processed more information. In this case lability is connected with volume of the looked through signs (by results of right hand tapping test – left hemisphere of brain) The volume of calculated pairs of figures is connected with fulfillment of left hand tapping test (right hemisphere of brain). When seeking letters, brain fulfills operations on re-coding of visual images (letters themselves) in motor commands to hands' muscles for formation of smooth sequential movements, required for writing. Thus, in organization of writing several specialized centers of brain participate (mainly of left hemisphere). If any of these centers is damaged there will be no skill in writing. It explains interconnections between results of correction test and tapping test, fulfilled by right hand. .

Explanation of Kreppeling's test indicators' correlations (written account of sums of figures' pairs) with indicators of right hemisphere's functioning is rather interesting. In general quantitative assessment of environment is sphere of dominant left hemisphere's functioning. While written depicting of figure (independent on which form they have Rome or Arabian, more close to hieroglyphic) manifest as a memory of right hemisphere. Without its participation any calculations on paper are impossible. I.e. speed of written calculation depends to large extent on functional activity of right hemisphere. Our results are proved in other research of students' fulfillment of drawings. (Kundey et al., 2013).

The quantity of mistakes, made by the participants, in creased in parallel with increasing of volume of fulfilled works. I.e. speed and quality of work are differently directed processes. However, analysis of counting test indicators showed that the volume and quantity of mistakes had confident negative correlation: the slower the test was fulfilled, the more mistakes were made by students. It can be explained by specificities of right hemisphere's operation and inter-hemispheres' interactions. If in correction test left hemisphere dominates, then, in counting test both hemispheres participate (which, in our case, worked in not sufficient agreement). The relevance of such approach is proved by research of arithmetic tests' influence on students' working memory (Ishak et al., 2012).

The data, received by us showed rather high physiological price for progress in learning. It was pointed by the absence of correlations with most of mental workability indicators. Exclusion was strength and lability of nervous system in fulfillment of right hand tapping test. With it, the lower strength and stress resistance of nervous system were the better was progress in studying. I.e. the higher speed properties of brain left hemisphere are the better is progress in studying. However, it is insufficient for coordinated cooperation of all links of mental workability, which is required for ensuring good progress without damage of students' health.

For example, Tishchenko V.A. (2012) studied interdependences of physical condition and students' educational progress. He found close correlation between mental workability indicators and students' physical condition. In other work authors analyzed physical aerobic workability on example of two groups of girl students with different physical fitness (Mahlovanyy, Kuninec, Jaworski, & T'orlo, 2012). In this case annual dynamic of physical workability indicators demonstrated advantages of girl students, who practiced sports.

The processes of inter-hemispheres' interconnection are rather interesting High lability of right and left hemispheres were inter-conditioned: the higher lability of left hemisphere was the higher was its stress-resistance. Connections between strength and stress-resistance in right hemisphere were not detected by us. Nervous processes' lability is rather stable characteristic. Specific features of interconnections between strength and lability indicators reflect the processes of mental fatigue, which expressed in left hemisphere (responsible, mainly, for abstract thinking).

The received data shall be assessed from positions of theory of functional systems by Anokhin P.K. (1971). Correction test results reflect stable condition of workability in interval Monday-Wednesday with gradual reduction by the end of week. These results are the most approached to classic assessment. They shall be assessed as reflection of gradual formation of fatigue (phases of expressed fatigue). It is proved by reduction of work volume and increase of mistakes' quantity. Tapping test's results are the most stable and have tendency for increasing. For example strength indicators practically did not change for the period of observation, while lability reduced. It reflects increase of stability, which was the most expressed for right hand.

One more symptom of pre-nosology's progressing increase of system's asymmetry shall be recognized. As tapping test's results witness, at the end of week difference between right and left hand' lability indicators are maximal. Against the background of workability weakening asymmetry increases – indicator of left hand is confidently lower than of right hand. In most of people just right hand is stronger. That is why such state proves that system, put in unfavorable conditions, tries to reach success at the account of simplification (in this context – by exclusion of weak link). Other data (Proskurov, 2015) are close to the received by us. The author studied dynamic of changes of somatic health, physical condition, physical and mental workability of schoolchildren under influence of comprehensive education load at the end of first academic semester. It was found that the reason of children health's worsening appear at the account of increase of intellectual pressure. This pressure is impossible to be overcome only by physical education means, directed at recreation and improvement of pupils' organism. Results of Kreppeling's test turned out to be the most unexpected, which in week cycle reduced in interval Monday-Wednesday and increased in period Wednesday-Friday. The same changes were observed also in dynamic of initial days. It shall be interpreted as a proof of formation of expressed fatigue (reduction of volume and worsening of accuracy).

Conclusions

Thus, results of all fulfilled tests (independent on dynamic) shall be assessed as reflection of gradual fatigue's formation. It is proved by changes of volume and accuracy of work's fulfillment. The state of mental workability shall be assessed as unsatisfactory: initial workability level was low; asymmetry and multidirectional changes were observed. The presence of such changes witnesses about multi-factorial fatigue, resulting from system's overloading. The main characteristic of such fatigue is not economizing functioning. Some links function by different mechanisms (increase, stability, reduction). Against the background of system functioning's low initial level it shall be assessed as unsatisfactory state and as reflection of pre-nosological state formation. This assumption can be illustrated also by the fact that subjective feelings of most of participants can be assessed as negative. Self assessment of health contains complaints, characteristic for over-fatigue. I.e. in this case mental workability is an indicator of functional state. It reflects imbalance of regulatory mechanisms. In its turn such imbalance is characteristic for pre-nosological states.

Dynamic of weekly cycle results shall be assessed as evidence of functioning at lower level: system sacrifices success and progress for the sake of work's stability and simplification.

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References

Ahmadi, M., Abdollahi, M. H., Ramezani, V., & Heshmati, R. (2010). The impact of written emotional expression on depressive symptoms and working memory capacity in Iranian students with high depressive symptoms. *Procedia - Social and Behavioral Sciences*, *5*, 1610–1614. doi:10.1016/j.sbspro.2010.07.334

Alloway, T. P., Bibile, V., & Lau, G. (2013). Computerized working memory training: Can it lead to gains in cognitive skills in students? *Computers in Human Behavior*, *29*(3), 632–638. doi:10.1016/j.chb.2012.10.023

Anokhin, P.K. (1971). *Principial'nye voprosy obshchej teorii funkcional'nykh sistem* [Principles of general theory of functional systems], Moscow.

Antomonov, M.Iu. (2006). *Matematicheskaia obrabotka i analiz medikobiologicheskikh dannykh* [Mathematical processing and analysis of biomedical data], Kiev.

Bliznevsky, A., Kudryavtsev, M., Kuzmin, V., Tolstopyatov, I., Ionova, O., & Yermakova, T. (2016). Influence of personal characteristics of pupils and students on the effectiveness of the relationship to the specific physical activities. *Journal of Physical Education and Sport, 16*(2), 424–432. doi:10.7752/jpes.2016.02066

Bliznevsky, A.A., Kudryavtsev, M.D., Iermakov, S.S., & Jagiełło, Władysław. (2016). Formation of active-effective attitude of 12–13 years' judo athletes to sports functioning in competition period. *Archives of Budo, 12*, 101–115.

Bondarenko, S.V., Darzinska, N.O., & Sidilo, L.V. (2015). Formation of 17-18 yrs age girl students' visual performance by means of visual training at stage of adaptation to learning loads. *Pedagogics,*

psychology, medical-biological problems of physical training and sports, *4*, 10–15. doi:10.15561/18189172.2015.0402

Buszard, T., Farrow, D., Zhu, F. F., & Masters, R. S. W. (2016). The relationship between working memory capacity and cortical activity during performance of a novel motor task. *Psychology of Sport and Exercise*, *22*, 247–254. doi:10.1016/j.psychsport.2015.07.005

Byshevets, N.G. (2012). Means of physical education as basis of measures for renewal of mental capacity of students in the conditions of informatization of education. *Pedagogics, psychology, medical-biological problems of physical training and sports, 5*, 10–13.

Dzierzanowski, M., Dzierzanowski, M., Maćkowiak, P., Słomko, W., Radzimińska, A., Kaźmierczak, U., . . . Zukow, W. (2013). The influence of active exercise in low positions on the functional condition of the lumbar-sacral segment in patients with discopathy. *Advances in Clinical and Experimental Medicine, 22*(3), 421-430.

Eksterowicz, J., Napierała, M.P., Żukow, W. (2016). How the Kenyan runner's body structure affects sports results. *Human Movement, 17*, (1), 8-14. doi:10.1515/humo-2016-0002

Furley, P., & Wood, G. (2016). Working Memory, Attentional Control, and Expertise in Sports: A Review of Current Literature and Directions for Future Research. *Journal of Applied Research in Memory and Cognition*. doi:10.1016/j.jarmac.2016.05.001

Furley, P., & Wood, G. (2016). Working Memory, Attentional Control, and Expertise in Sports: A Review of Current Literature and Directions for Future Research. *Journal of Applied Research in Memory and Cognition*. Retrieved from http://linkinghub.elsevier.com/retrieve/pii/S2211368116300730

Gumenniy, V. (2011). Influences of physical training on intellectual working capacity and psychoemotional stability of students depending on specificity of professional work. *Pedagogics, psychology, medical-biological problems of physical training and sports*, *1*, 45 – 47.

Iermakov, S., Podrigalo, L., Romanenko, V., Tropin, Y., Boychenko, N., Rovnaya, O., & Kamaev, O. (2016). Psycho-physiological features of sportsmen in impact and throwing martial arts. *Journal of physical education and sport, 16*(2), 433–441. doi:10.7752/jpes.2016.02067

Iermakov, S.S., Podrigalo, L.V., & Jagiełło, W. (2016). Hand-grip strength as an indicator for predicting the success in martial arts athletes. *Archives of Budo, 12*, 179–186.

Iermakov, S.S.; Cieślicka, M., & Muszkieta, R. (2015). Physical culture in life of Eastern-European region students: modern state and prospects of development. *Physical Education of Students*, *6*, 16–30. doi:10.15561/20755279.2015.0603

Ishak, I., Jufri, N. F., Lubis, S. H., Saat, N. Z. M., Omar, B., Arlin, R., … & Mohamed, N. (2012). The Study of Working Memory and Academic Performance of Faculty of Health Sciences Students. *Procedia – Social and Behavioral Sciences*, *60*, 596–601. doi:10.1016/j.sbspro.2012.09.428

Ivashchenko, O., Khudolii, O., Yermakova, T., Iermakov, S., Nosko, M., & Nosko, Y. (2016). Factorial and discriminant analysis as methodological basis of pedagogic control over motor and functional fitness of 14–16 year old girls. *Journal of physical education and sport, 16*(2), 442–451. doi:10.7752/jpes.2016.02068

Ivashchenko, O.V., Yermakova, T.S. (2015a). Assessment of functional, coordination and power fitness of 7–8 form boys. *Pedagogics, psychology, medical-biological problems of physical training and sports*, *9*, 20–25. doi:10.15561/18189172.2015.0903

Ivashchenko, O.V., Yermakova, T.S. (2015b). Structural model of in-group dynamic of 6–10 years old boys' motor fitness. *Pedagogics, psychology, medical-biological problems of physical training and sports*, *10*, 24–32. doi:10.15561/18189172.2015.1004

Iermakov, S.S., Ivashchenko, P.I., & Guzov, V.V. (2012). Features of motivation of students to application of individual programs of physical self-preparation. *Physical Education of Students*, *4*, 59–61.

Kopylov, Yu.A., Jackowska, L.N., Kudryavtsev, M.D., Kuzmin, V.A., Tolstopyatov, I.A., & Iermakov, S.S. (2015). The concept of structure and content of health related trainings for higher educational establishments' students. *Physical Education of Students*, *5*, 23–30. doi:10.15561/20755279.2015.0504

Korobeynikov, G., Korobeynikova, L., Iermakov, S., & Nosko, M. (2016). Reaction of heart rate regulation to extreme sport activity in elite athletes. *Journal of Physical Education and Sport, 16*(3), 976–981. doi:10.7752/jpes.2016.03154

Korobeynikov, G.V., Petrov, G.S., & Ulizko, V.M. (2010). Mental capability of higher school students. *Pedagogics, psychology, medical-biological problems of physical training and sports*, *4*, 68 – 72.

Kozina, Z., Repko, O., Ionova, O., Boychuk, Y., & Korobeinik, V. (2016). Mathematical basis for the integral development of strength, speed and endurance in sports with complex manifestation of physical qualities. *Journal of Physical Education and Sport, 16*(1), 70–76. doi:10.7752/jpes.2016.01012

Kozina, Z.L., & Iermakov, S.S. (2015). Analysis of students' nervous system's typological properties, in aspect of response to extreme situation, with the help of multi-dimensional analysis. *Physical Education of Students*, *3*, 10–19. doi:10.15561/20755279.2015.0302

Kundey, S.M.A., De Los Reyes, A., Rowan, J.D., Lee, B., Delise, J., Molina, S., & Cogdill, L. (2013). Involvement of working memory in college students' sequential pattern learning and performance. *Learning and Motivation*, *44*(2), 114–126. doi:10.1016/j.lmot.2012.09.001

Kurata, Y.B., Bano, R.M.L.P., & Matias, A.C. (2015). Effects of Workload on Academic Performance among Working Students in an Undergraduate Engineering Program. *Procedia Manufacturing*, *3*, 3360–3367. doi:10.1016/j.promfg.2015.07.497

Kuzmin, V. A., Kopylov, Y. A., Kudryavtsev, M. D., Tolstopyatov, I. A., Galimov, G. Y., & Ionova, O. M. (2016). Formation of professionally important qualities of students with weakened motor fitness using a health related and sport-oriented training program. *Journal of Physical Education and Sport, 16*(1), 136–145. doi:10.7752/jpes.2016.01023

Kuzmin, V.A., Kopylov, Yu.A., Kudryavtsev, M.D., Galimov, G.Y., & Iermakov, S.S. (2015). Substantiation of effectiveness of trainings on health related methodic for students with weakened motor fitness. *Physical Education of Students*, *6*, 43–49. doi:10.15561/20755279.2015.0606

Lupu, E. (2015). A Study Regarding the Impact of Motor Activities on the Students' Working Memory. *Procedia – Social and Behavioral Sciences*, *187*, 514–519. doi:10.1016/j.sbspro.2015.03.096

Mahlovanyy, V.A., Kuninec, O.B., Jaworski, T.I., & T'orlo, O.I. (2012). Dynamics of indexes of students' physical capacity of medical university. *Physical education of students*, *2*, 63 – 66.

Makarenko, N.V. (1996). *Teoreticheskie osnovy metodiki professional'nogo psikhofiziologicheskogo otbora voennykh specialistov* [Theoretical principles of methodic of military specialists' professional psycho-physiological selection], Kiev.

Masaaki, T., Akira, I., & Yasuyoshi, W. (2016). Neural effect of physical fatigue on mental fatigue: a magnetoencephalography study. *Fatigue: Biomedicine, Health & Behavior, 4* (2), 104–114.

Nosko, M., Razumeyko, N., Iermakov, S., & Yermakova, T. (2016). Correction of 6 to 10-year-old schoolchildren postures using muscular-tonic imbalance indicators. *Journal of Physical Education and Sport, 16*(3), 988–999. doi:10.7752/jpes.2016.03156

Petrenko, N.V. (2013). The dynamics of physical and mental health of students of economic specialties in the course of employment aqua. *Pedagogics, psychology, medical-biological problems of physical training and sports*, *11*, 67–71. doi:10.6084/m9.figshare.817928

Podrigalo, L.V., & Danylenko, G.N. (2014). *Donozologicheskiye sostoyaniya u detey, podrostkov i molodezhi: diagnostika, prognoz i gigiyenicheskaya korrektsiya* [Prenosological condition in children, adolescents and young adults: diagnosis, prognosis and hygienic correction], Kiev: Geneza.

Pomeshchikova, I. P., Shevchenko, O. O., Yermakova, T. S., Paievskyi, V. V., Perevoznyk, V. I., Koval, M. V., . . . Moiseienko, O. K. (2016). Influence of exercises and games with ball on coordination abilities of students with disorders of muscular skeletal apparatus. *Journal of Physical Education and Sport, 16*(1), 146–155. doi:10.7752/jpes.2016.01024

Priscilla E., Ellie F., & Linsey. (2015). Postsecondary study and mental ill-health: a meta-synthesis of qualitative research exploring students' lived experiences. *Journal of Mental Health, 24*, (2), 111–119.

Proskurov, E.M. (2015). Dynamic of changes in health of 10–11 years old gymnasium boys under influence of comprehensive education's load. *Pedagogics, psychology, medical-biological problems of physical training and sports*, *7*:39–47. doi:10.15561/18189172.2015.0706

Pryimakov, O., Iermakov, S., Kolenkov, O., Samokish, I., & Juchno, J. (2016). Monitoring of functional fitness of combat athletes during the precompetitive preparation stage. *Journal of physical education and sport, 16*(2), 551–561. doi:10.7752/jpes.2016.02087

Prysjazhnuk, S.I. (2012). Influence of small forms of active rest on intellection of students of agrarian higher institutes. *Pedagogics, psychology, medical-biological problems of physical training and sports*, *11*, 76–79.

Rovnaya, O.A., Podrigalo, L.V., Aghyppo, O.Y., Cieślicka, M., & Stankiewicz, B. (2016). Study of Functional Potentials of Different Portsmanship Level Synchronous Swimming Sportswomen under Impact of Hypoxia. *Research Journal of Pharmaceutical, Biological and Chemical Sciences, 7* (4), 1210–1219.

Skurikhina, N.V., Kudryavtsev, M.D., Kuzmin, V.A., & Iermakov, S.S. (2016). Fitness yoga as modern technology of special health groups' girl students' psycho-physical condition and psycho-social health strengthening. *Physical Education of Students*, *20*(2), 24–31. doi:10.15561/20755279.2016.0204

Sobko, I.N., Kozina, Zh.L., Iermakov, S.S., Muszkieta, R., Prusik, Kr., Cieślicka, M., Stankiewicz, B. (2014). Comparative characteristics of the physical and technical preparedness of the women's national team of Ukraine and Lithuania basketball (hearing impaired) before and after training to Deaflympic Games. *Pedagogics, psychology, medical-biological problems of physical training and sports*, *10*, 45–51. doi:10.5281/zenodo.10490

Tishchenko, V.A. (2012). Influence of students' physical development on their professional teaching. *Physical Education of Students*, *2*, 96–99.

Vasile, C. (2012). Working Memory and the feeling of success in students. *Procedia – Social and Behavioral Sciences*, *33*, 781–785. doi:10.1016/j.sbspro.2012.01.228