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MODELING OF COGNITIVE ACTIVITY OF HIGH SCHOOL CHILDREN USING ICTs

Problem setting. The global trends of training modernization, the growing importance of the research competencies of specialists for the world labor market necessitate the use of ICTs that can be used not only for assessing pupils' cognitive abilities, but also for their in-depth study through simulation [1].

Analysis of recent research and publications. The solution of the problem is based on the features of the modern learning environment, including synthetic [2], the need to take into account the emerging problems of student safety [3], their cognitive and academic capabilities [4], the influence of external factors [5] and the micro-age features of the formation of their personal and intellectual [6] capabilities.

The goal of the work. Analysis of the experience of using ICT for modeling and monitoring cognitive activity of adolescents.

Methods. For the study, the applied testing technique used in the research [7] is implemented as a local and on-line toolkit supplemented by the use of the Solveig computerized complex and cloud resources for registering the Earth's magnetosphere and meteorological indices. The registered indicators are stored in the developed database for the purpose of further analysis and modeling of the influence of internal and external factors on cognitive activity of a person. The survey includes performing psychological tests and parallel recording of the duration of ECG RR intervals (continuous using the Solveig apparatus) and arterial pressure of the systolic APS and diastolic APD before the start (index "1") and after ("2") of the tests. Cognitive tests: logic-combinatorial at a "free" rate (T6) and with a limited runtime (T5).

Results. Cognitive (cognitive) abilities are a key factor in learning activities. Therefore, monitoring the cognitive oscillation of high school students is an important indicator of the effectiveness of the school process. If the average time of performing test tasks in the "free" (T6 test) and in the fixed (test T5) tempo after a certain period of "training" becomes relatively stable (Fig. 1), then from the graphs of fluctuations in blood pressure (Fig. 2) It can be seen that even during the adaptation to the activity, there are days of improvement and deterioration of the result.

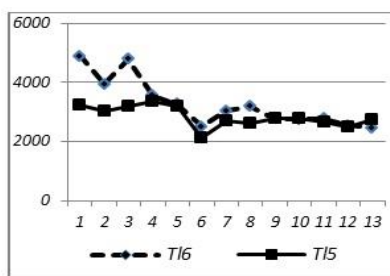


Fig 1. Tests time performance changes, ms (X-axis - testing days)

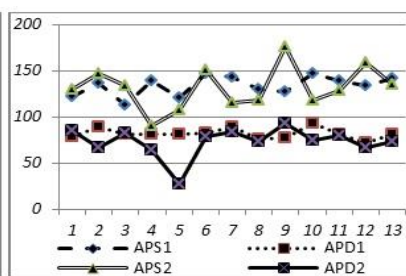


Fig 2. Dynamics of blood pressure of the same subject

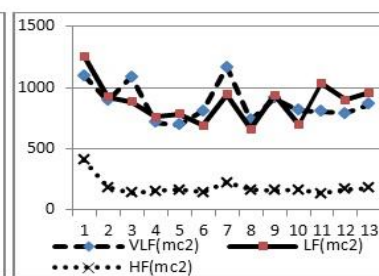


Fig 3. Day-to-day dynamics of heart rate indices' power

Under the influence of natural and social fluctuations in the psychological and physiological state of a person, one can expect certain changes and in the state of his/her health. For the purpose of the corresponding analysis, the results of the registration of electrocardiogram subjects with the analysis of the spectrum of the heart rate rhythm according to international standards [7] were used, and the analysis of the power of the spectrum of oscillations was performed in three bands: slow fluctuations of the LF (based on the baroreflexory mechanisms, which more and more researchers are associated with stability of cognitive processes), overload VLF and high-frequency HF). The corresponding dynamics of the state of the cardiovascular system (CVS) of the same tester (Fig. 3) allows us to conclude on the adaptation of its CVS to this type of cognitive activity (given data for the registration of the CVS before the start of testing). Further analysis of the data using multiple correlation analysis revealed to a close and reliable connection of the rate and reliability η indicators performance of tests with autonomic regulation parameters (heart rate and arterial pressure), nervous system properties (strength and functional mobility of nervous processes)

and external factors (the speed of the solar wind SW and the density of its proton component n). Corresponding values of multiplier correlation coefficient and reliability level are as follows: $R^6 = 0.7 \dots 0.93$ ($p < 0.01$), $R^5 = 0.95 \dots 0.97$ ($p < 0.001$), $R^6 \eta = 0.88 \dots 0.91$ ($p < 0.01$), $R^5 \eta = 0.95 \dots 0.97$ ($p < 0.01$).

Conclusions. The use of information and communication technologies allows to carry out psychological and psychophysiological researches of cognitive possibilities of a pupil in conditions of school learning. Accounting of external and internal factors allows to predict the student adaptive ability to the learning process, the level of mental performance, and therefore the success of solving cognitive tasks of different types.

References

1. Pinchuk O. Cognitive activity of students under conditions of digital transformation of learning environment / O. Pinchuk, O. Sokolyuk // Informational Technologies in Education. – 2018. – № 36. – P. 71-81.
2. Пінчук О.П., Литвинова С.Г., Буров О.Ю. Синтетичне навчальне середовище – крок до нової освіти / О. П. Пінчук, С. Г. Литвинова, О. Ю. Буров // *Інформаційні технології і засоби навчання*. 2017. № 4 (60). с. 28-45. [Електронний ресурс]. Доступно: <https://journal.iitta.gov.ua/index.php/itlt/article/view/1831>.
3. Burov O.Y. Educational networking: human view to cyber defense / O. Y. Burov // *Інформаційні технології і засоби навчання*. – 2016. – №. 52, вип. 2. – С. 144-156.
4. Буров О.Ю., Камишин В. В. Оцінювання обдарованості: проблеми кількісної міри / О. Ю. Буров, В. В. Камишин // *Навчання і виховання обдарованої дитини: теорія та практика*. – К.: Інститут обдарованої дитини АПН України. – 2004. – Вип. 2 (2009): 5-9.
5. Ratynska O. Mental capacity to work of senior pupils in different weather types. – Manuscript. Scientific thesis for the Degree of the Candidate of Biological Sciences in the speciality 03.00.13 – human and animal physiology. – Kyiv National University named after Taras Shevchenko, Kyiv, 2005.
6. Буров О.Ю. Динаміка розвитку інтелектуальних здібностей обдарованої особистості у підлітковому віці / О. Ю. Буров, В. В. Рибалка, Н. Д. Вінник, В. В. Русова, М. А. Перцев, І. О. Плаксенкова, М. О. Кудрявченко, А. Б. Сагалакова, Ю. М. Черняк; За ред. О. Ю. Бурава. – К. : Тов «Інформаційні системи», 2012. – 258 с.
7. Heart rate variability: Standards of measurement, physiological interpretation and clinical use / Task Force of European Society of Cardiology and the North American Society of Pacing and Electro-physiology // *Circulation*. – 1996. – 93. – 1043-1065.

Анотація. Буров О.Ю., Пінчук О.П., Соколюк О.М., Перцев М.А. *Моделювання пізнавальної діяльності старшокласників з використанням ІКТ. Розглянуто проблеми, пов'язані з моделюванням виконання когнітивних завдань старшокласниками під впливом змін внутрішніх та зовнішніх факторів. Розроблена ІКТ дозволила встановити інтер-персональні та інтра-персональні зміни показників ефективності та надійності виконання когнітивних тестів протягом часу обстеження (1,5 місяця при тестуванні 3 рази на тиждень).*

Ключові слова: інтелект, оцінювання, експериментальні дослідження, комп'ютерні засоби.

Аннотация. Буров А.Ю., Пинчук О.П., Соколюк А.Н., Перцев М.А. *Моделирование познавательной деятельности старшеклассников с использованием ИКТ. Рассмотрены проблемы, связанные с моделированием выполнения когнитивных задач старшеклассниками под влиянием изменений внутренних и внешних факторов. Разработанная ИКТ позволила установить интер-персональные и интра-персональные изменения показателей эффективности и надежности выполнения когнитивных тестов в течение времени обследования (1,5 месяца при тестировании 3 раза в неделю).*

Ключевые слова: интеллект, оценка, экспериментальные исследования, компьютерные средства.

Abstract. Burov O.Yu., Pinchuk O.P., Sokolyuk O.M., Pertsev M.A. *Modeling of cognitive activity of high school children using ICTs. The problems associated with modeling the performance of cognitive tasks by high school students under the influence of changes in internal and external factors are considered. The developed ICT allowed to establish inter-personal and intra-personal changes in the indicators of efficiency and reliability of performing cognitive tests during the survey period (1.5 months when tested 3 times a week).*

Key words: intelligence, measurement, experimentation, computer tools.

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ICT ASSESSMENT OF INTELLECTUAL DEVELOPMENT OF A PUPIL FOR THE DIFFERENTIATION OF TRAINING IN THE RESEARCH DIRECTION

Statement of the problem. Development of technologies in the XX century has posed to teachers the issues of modernizing the class-lesson system of training, taking into account the capabilities and needs of the pupil as much as possible. One of the approaches to solving this problem is differentiated education, a kind of which can be specialized education, which is popular and legally supported in Ukraine.