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STRUCTURED PHYSICAL CULTURE AS A PSYCHOPHYSIOLOGICAL STRATEGY FOR REDUCING DIGITAL FATIGUE AMONG UNIVERSITY STUDENTS

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Abstract

In the digital transformation of higher education, students spend an increasing part of their academic and personal life in front of screens, which changes not only the method of learning but also the structure of movement, rest, communication and self-regulation. The article examines structured physical culture as a psychophysiological and pedagogical strategy for reducing digital fatigue among university students. Digital fatigue is interpreted as a complex condition that includes visual strain, sedentary overload, attention fragmentation, emotional tension, sleep instability, reduced motivation and weakening of bodily self-awareness. The purpose of the study is to justify a model in which physical culture functions not merely as a discipline for developing motor skills, but as a health-preserving educational mechanism that compensates for sedentary screen-based learning and supports mental well-being. The research is based on theoretical analysis, comparative synthesis of scientific sources, interpretation of international physical activity recommendations and pedagogical modeling. The proposed model includes four components: motor activation, psychophysiological recovery, digital-hygienic education and reflective self-monitoring. The article argues that moderate aerobic exercises, posture correction, mobility tasks, breathing regulation, group movement and short active breaks can reduce the consequences of digital overload by restoring circulation, improving muscle tone, stabilizing emotional state and strengthening self-control. It is concluded that physical culture in the digital era should be integrated into university strategies of student well-being, because the culture of movement is becoming a necessary condition for sustainable learning, mental resilience and responsible digital behavior.

Keywords: Physical culture, digital fatigue, university students, sedentary behavior, psychophysiological well-being, physical activity, mental health, digital hygiene, self-regulation, higher education.

Introduction

Annotatsiya

Oliy ta'lim jarayonining raqamlashtirilishi sharoitida talabalar akademik va shaxsiy hayotining katta qismini ekran qarshisida o'tkazmoqda. Bu holat ta'lim olish usullarini emas, balki harakat tartibi, dam olish, muloqot va o'zini boshqarish mexanizmlarini ham o'zgartirmoqda. Mazkur maqolada tizimli jismoniy madaniyat mashg'ulotlari universitet talabalari orasida raqamli charchoqni kamaytirishning psixofiziologik va pedagogik strategiyasi sifatida tahlil qilinadi. Raqamli charchoq ko'z zo'riqishi, kamharakatlik, diqqatning parchalanishi, emotsional taranglik, uyqu beqarorligi, motivatsiya pasayishi va tanaviy o'zini anglashning susayishi bilan bog'liq murakkab holat sifatida izohlanadi. Tadqiqotning maqsadi jismoniy madaniyatni faqat harakat ko'nikmalarini rivojlantiruvchi fan emas, balki ekran asosidagi o'qishdan kelib chiqadigan salbiy ta'sirlarni yumshatuvchi, ruhiy farovonlikni qo'llab-quvvatlovchi sog'lomlashtiruvchi pedagogik mexanizm sifatida asoslashdan iborat. Maqolada motor faollashtirish, psixofiziologik tiklanish, raqamli gigiyena va refleksiv o'zini monitoring qilish komponentlaridan iborat model taklif etiladi.

Kalit so'zlar: jismoniy madaniyat, raqamli charchoq, talabalar, kamharakatlik, psixofiziologik farovonlik, jismoniy faollik, ruhiy salomatlik, raqamli gigiyena, o'zini boshqarish, oliy ta'lim.

Аннотация

В условиях цифровизации высшего образования студенты всё больше времени проводят перед экраном, что меняет не только способы обучения, но и режим двигательной активности, отдыха, общения и саморегуляции. В статье рассматривается структурированная физическая культура как психофизиологическая и педагогическая стратегия снижения цифровой усталости у студентов вузов. Цифровая усталость понимается как комплексное состояние, включающее зрительное напряжение, малоподвижную перегрузку, фрагментацию внимания, эмоциональное напряжение, нестабильность сна, снижение мотивации и ослабление телесного самосознания. Цель исследования заключается в обосновании модели, в которой физическая культура выступает не только дисциплиной развития двигательных навыков, но и здоровьесберегающим образовательным механизмом, компенсирующим последствия экранного обучения и поддерживающим психическое благополучие студентов. Исследование основано на теоретическом анализе, сравнительном синтезе научных источников, интерпретации международных рекомендаций по физической активности и педагогическом моделировании. Предложенная модель включает двигательную активизацию, психофизиологическое восстановление, цифровую гигиену и рефлексивный самоконтроль.

Ключевые слова: физическая культура, цифровая усталость, студенты, малоподвижное поведение, психофизиологическое благополучие, физическая активность, психическое здоровье, цифровая гигиена, саморегуляция, высшее образование.

Introduction

The rapid digitalization of higher education has produced a new educational environment in which the student learns, communicates, writes, reads, prepares presentations, searches for literature and relaxes through the same digital interface. A laptop, tablet or smartphone is no longer an additional technical instrument; for many students it has become the central space of academic existence. This transformation has obvious advantages: access to electronic libraries becomes easier, distance learning expands educational opportunities, communication with teachers accelerates, and academic materials can be stored, copied and revised with unprecedented speed. Yet the same process creates a serious contradiction between intellectual intensity and bodily passivity. A student may attend lectures through an online platform, read electronic textbooks, answer messages, complete assignments, use social networks and watch educational videos during one day, while the body remains in a seated position for many hours. Such a lifestyle forms the basis of digital fatigue. In this article digital fatigue is understood as a complex psychophysiological state caused by prolonged screen exposure, sedentary behavior, permanent information switching and insufficient recovery. It includes visual strain, headache, neck and back discomfort, sleep disruption, emotional irritability, low motivation, attention instability and a subjective feeling of cognitive exhaustion. Unlike ordinary tiredness, digital fatigue is not only the result of hard work; it is the result of an unbalanced interaction between the nervous system, the musculoskeletal system, information overload and behavioral habits. The problem is especially relevant for university students because their academic success depends on attention, memory, motivation and self-regulation, while their daily educational environment increasingly weakens the physical foundations of these functions. Physical culture has traditionally been included in higher education as a discipline for developing strength, endurance, flexibility, coordination, motor skills and general health. However, in the digital era its meaning must be expanded. It should also be regarded as a preventive pedagogical technology that protects students from the consequences of sedentary screen-based learning. The body is not a passive container for the mind; it is an active condition of cognitive performance. When movement is insufficient, blood circulation, posture, breathing depth, muscular tone and emotional regulation deteriorate. When physical activity is structured and regular, it can restore physiological balance and create a more stable basis for learning. International guidelines on physical activity emphasize that adults should engage in regular moderate or vigorous movement and reduce sedentary behavior [1]. This recommendation is not a decorative public-health slogan; it directly concerns

students, because university life often normalizes sitting as the main academic posture. Scientific literature also indicates that physical activity is associated with lower risk of depression, better mood and stronger psychological resilience [2]. At the same time, excessive screen time and mobile phone dependence are frequently discussed as factors connected with poorer sleep, anxiety, reduced academic productivity and emotional instability among young people [3]. The scientific problem of the present article is that physical culture is still insufficiently integrated into the discourse of digital well-being in universities. Psychological support, digital literacy and physical education are often treated as separate areas, although in student life they are closely connected. A student who does not sleep well because of late-night smartphone use will not show high learning motivation in the morning; a student who sits for six hours without active breaks will not maintain stable attention; a student whose body is tense and inactive will experience digital learning as more exhausting. Therefore, the purpose of this article is to justify structured physical culture as a psychophysiological strategy for reducing digital fatigue among university students. The object of the study is the health-preserving educational process in higher education, and the subject is the role of structured physical culture in regulating the consequences of digital overload. The main tasks are to clarify the concept of digital fatigue, analyze its bodily and psychological manifestations, identify mechanisms through which physical activity can reduce digital overload, construct a practical model for university physical culture classes and formulate recommendations for pedagogical implementation. The novelty of the article lies in interpreting physical culture not only as a sports or fitness discipline, but as a component of digital-era mental hygiene. Such an interpretation is important for the field of physical culture because future specialists must be able to work not only with traditional physical development, but also with new risks created by digital lifestyles.

Methods

The research was conducted as a theoretical and methodological study, because the aim was to develop a scientifically grounded conceptual model rather than to report the results of a single local experiment. This design is appropriate for a topic that connects several fields: physical culture, educational psychology, student health, digital hygiene and psychophysiology. The methodological basis included theoretical analysis of scientific literature, comparative synthesis of physical activity recommendations, pedagogical modeling and logical interpretation of mechanisms through which movement may influence digital fatigue. The literature analysis focused on three groups of sources. The first group included international recommendations and studies on physical activity, sedentary behavior and health outcomes. These sources made it possible to define physical culture not only as a pedagogical subject, but also as a public-health instrument. The second group included psychological and educational literature on student well-being, stress, motivation, self-regulation and mental health. These sources helped explain why

digital fatigue cannot be reduced to eye strain or technical overload alone. The third group included research on screen time, mobile phone use, sleep quality and digital behavior among young people. These sources were used to identify the behavioral context in which modern students study and rest. The modeling method was applied to transform these theoretical findings into a practical structure suitable for university physical culture. Four methodological principles guided the development of the model. The first principle is compensation: physical culture must compensate for the static posture, reduced muscular activity and limited energy expenditure typical of long screen-based learning. The second principle is regulation: physical culture must help students regulate breathing, emotional tension, attention and bodily awareness, because digital fatigue involves nervous-system overload. The third principle is differentiation: exercise content must be adapted to the physical preparedness, health condition and motivation of students, since excessive training loads may increase fatigue and reduce participation. The fourth principle is integration: physical culture must be connected with digital hygiene, sleep discipline, learning rhythm and self-monitoring, otherwise the positive effects of movement remain limited to the classroom. The proposed model was therefore built on three analytical levels. The bodily level includes posture correction, mobility, aerobic work, strength endurance and prevention of musculoskeletal discomfort. The psychophysiological level includes reduction of emotional tension, improvement of sleep readiness, stabilization of breathing, restoration of attention and development of self-regulation. The pedagogical-behavioral level includes motivation, group interaction, conscious habit formation, reflective diaries and independent movement practice. The article also uses the logic of self-determination theory, according to which students are more likely to maintain healthy behavior when they experience autonomy, competence and social belonging [4]. In physical culture this means that the student should not only obey instructions, but understand the purpose of exercises, feel progress and participate in a supportive group environment. The social-cognitive approach is also relevant, because students develop health behavior through observation, self-efficacy and repeated successful experience [5]. In methodological terms, the study assumes that structured physical culture should include not only main training sessions, but also micro-practices that can be used during the academic day: active breaks, breathing pauses, short mobility complexes, walking intervals and posture reset routines. The limitation of this design is that it does not present numerical data from one particular group of students; therefore, the findings should be regarded as a theoretical basis for future empirical research. Nevertheless, theoretical modeling has practical value because it allows universities to design intervention programs before conducting experimental verification. A future empirical study based on this model may use pre-test and post-test indicators such as perceived digital fatigue, sleep quality, physical activity level, back and neck discomfort, attention stability, anxiety level, mood, academic self-efficacy and frequency of active breaks during screen-based study.

Results

The theoretical analysis produced several interrelated results. The first result is the clarification of digital fatigue as a multidimensional condition with cognitive, emotional, physical and behavioral components. Cognitive symptoms include reduced concentration, slower information processing, difficulty completing long tasks, increased distractibility and the feeling that the mind is overloaded even when the actual academic task is not very difficult. Emotional symptoms include irritability, anxiety, apathy, reduced interest in learning and the sense of being permanently tired. Physical symptoms include eye discomfort, headache, neck stiffness, shoulder tension, lower-back pain, shallow breathing and general bodily heaviness. Behavioral symptoms include procrastination, frequent checking of the phone, late-night screen use, irregular sleep, reduced outdoor activity and avoidance of active leisure. This structure shows that digital fatigue is not simply a problem of willpower. It is a systemic state that emerges when the student repeatedly overloads attention while underloading the body. The second result is the identification of the compensatory function of structured physical culture. Prolonged sitting decreases muscular activation and creates static tension in the neck, back and shoulder areas. Screen-based posture often moves the head forward, rounds the upper back and limits diaphragmatic breathing. Physical culture can counteract these patterns through dynamic warm-ups, mobility drills, corrective exercises, walking, jogging, relay tasks, coordination exercises, stretching and light strength work. These forms of activity improve circulation, increase oxygen consumption, activate large muscle groups and interrupt the physiological monotony of sitting. The compensatory effect is especially important because students often underestimate the bodily cost of digital learning. They may think that studying online is less tiring than physical work, but the organism experiences a different kind of fatigue: the eyes and brain are overloaded, while the muscles are underused. Movement restores the missing component of activity. The third result is the identification of the regulatory function of physical culture. A well-designed physical culture session changes not only muscles and joints, but also the state of the nervous system. Rhythmic movement, controlled breathing, moderate aerobic load and relaxation after exercise can reduce excessive tension and help the student shift from fragmented digital attention to embodied awareness. This is essential because digital environments constantly stimulate external attention: notifications, messages, links, videos and rapid transitions pull the student outward. Physical culture brings attention back to breathing, balance, coordination, rhythm and bodily sensation. This process strengthens self-regulation. When students learn to recognize tension in the shoulders, shallow breathing or restlessness after long screen use, they become more capable of correcting their state before fatigue becomes chronic. The fourth result is the social-pedagogical value of physical culture. Digital learning can isolate students even when they are constantly connected. Online communication is fast, but it often lacks emotional depth, nonverbal feedback and collective rhythm. Physical culture classes create direct interaction, cooperation, mutual

support and healthy competition. Team games, paired exercises, group circuits and cooperative tasks allow students to experience belonging and shared effort. This social effect reduces emotional tension and increases motivation. It also supports the adaptation of first-year students who may feel uncertainty in a new academic environment. The fifth result is the development of a four-component model of physical culture for reducing digital fatigue. The first component is motor activation. It includes moderate aerobic activities, posture-oriented gymnastics, mobility training, dynamic stretching, coordination tasks and short movement breaks. Its goal is to reduce sedentary overload and activate the cardiovascular and musculoskeletal systems. The second component is psychophysiological recovery. It includes breathing exercises, relaxation after load, slow walking, static stretching, balance tasks and low-intensity movement practices. Its goal is to decrease nervous tension and support emotional stability. The third component is digital-hygienic education. It includes short explanations by the teacher about screen breaks, sleep hygiene, ergonomic sitting, evening smartphone use, the effect of notifications on attention and the need to alternate mental and physical activity. This component is necessary because students often do not connect their fatigue with digital habits. The fourth component is reflective self-monitoring. It includes weekly diaries, simple self-rating scales, personal goals and analysis of the relationship between screen time, movement, sleep and mood. Reflection transforms physical culture from a compulsory subject into a personal competence. The sixth result is the formulation of a practical weekly structure. In ordinary university conditions, students may participate in two physical culture classes per week, each lasting approximately 80-90 minutes, and complete two independent sessions of 20-30 minutes consisting of walking, mobility or light aerobic activity. During days with long online study, students may use 5-7-minute active breaks after 60-90 minutes of screen work. These breaks may include neck mobility, shoulder circles, spinal extension, hip mobility, breathing regulation, squats without overload and short walking. Once per week students may complete a reflective note: hours of screen use, physical activity, sleep duration, mood, discomfort level and the most useful recovery practice. The seventh result is the identification of pedagogical conditions necessary for the model. The teacher should avoid a purely normative approach in which students are evaluated only by speed, strength or sport technique. For reducing digital fatigue, the primary criteria should include regularity, safe load, conscious participation, personal progress and the ability to apply movement outside the class. The teacher should also create an inclusive environment, because students with low physical preparedness may be exactly those who need health-preserving physical culture most. Differentiated loads, supportive feedback and cooperative exercises are therefore essential. The eighth result is the conclusion that physical culture can function as a low-cost and highly accessible preventive strategy. Many digital health solutions require applications, platforms or paid services, while basic movement requires space, time and methodological literacy. This is not technological backwardness; it is physiological realism. The human

nervous system still needs rhythm, movement, sleep and direct communication, even if the university timetable has become digital.

Discussion

The results demonstrate that physical culture should be repositioned in higher education as a central component of digital well-being. This does not mean that physical culture must oppose digital technologies. Such an opposition would be naive, because digital tools are already embedded in academic life and will continue to develop. The correct question is not whether students should use digital technologies, but how they can use them without destroying the bodily and psychological conditions of learning. The proposed model answers this question by treating movement as a necessary regulator of the digital educational environment. Digital fatigue appears when the learning process becomes one-sided: the eyes and attention work continuously, while the muscles, breathing, posture and social body remain passive. Physical culture restores the missing side of learning. It gives the student a rhythm of effort and recovery, tension and relaxation, individual work and group interaction. This is why university physical culture should not be reduced to formal attendance or standard physical tests. Normative indicators may remain useful, but they must be supplemented by health-oriented and self-regulatory aims. The teacher should explain to students why movement improves attention, why breaks during screen work matter, why evening scrolling may damage sleep, why posture affects breathing and why moderate physical activity can reduce emotional tension. When students understand the mechanism, they are more likely to transfer physical culture into daily life. The discussion also requires a careful interpretation of screen time. Not every digital activity is harmful. Reading scientific literature, preparing assignments, participating in online courses and communicating with teachers can be academically productive. However, even productive screen time becomes risky when it is continuous, sedentary and poorly regulated. Passive and emotionally stimulating screen use, especially in the evening, may be more harmful than purposeful academic use. Therefore, digital hygiene should not be based on primitive prohibition. It should teach proportion, rhythm and conscious choice. Physical culture supports this process because it gives students an alternative form of regulation. Instead of resting from a laptop by using a smartphone, the student learns to rest from cognitive load through movement, breathing and change of environment. This is a small behavioral shift, but its educational meaning is large. In many cases, students do not lack information about health; they lack embodied habits. They know that physical activity is useful, but they do not know how to include it into a dense academic day. A structured model solves this problem by offering concrete micro-practices: active breaks, short walks, posture reset, breathing pauses and simple mobility complexes. The importance of intensity must also be discussed. Sport culture sometimes values high performance, competition and visible achievement. These values are not negative in themselves, but they may be unsuitable for students experiencing digital exhaustion, low motivation or weak physical preparedness.

If the first experience of physical culture is shame, pain or comparison with stronger students, the student may avoid movement. For preventive work, the first goal is regular positive contact with physical activity. Moderate load, gradual progression and emotional comfort are more important than immediate maximum intensity. Once adaptation is formed, intensity can increase. This approach corresponds to the principle of sustainable participation. Another important issue is the role of the teacher. In the digital era, a physical culture teacher should be not only a trainer, but also a designer of recovery environments. The teacher must observe the group, understand signs of fatigue, vary the load, combine activity and relaxation, encourage cooperation and integrate short health explanations into practice. For example, after a dynamic part of the lesson, the teacher may organize two minutes of controlled breathing and ask students to compare their state before and after activity. After posture exercises, the teacher may explain how forward-head posture develops during smartphone use. After an outdoor walk or running task, the teacher may discuss the relationship between daylight, sleep and mood. Such explanations should be brief, concrete and connected with bodily experience. Otherwise, physical culture risks becoming abstract moral instruction. The discussion also shows that reflective self-monitoring is a key condition of effectiveness. Students often do not see the connection between their habits and their state. A weekly diary can make this connection visible. If a student writes that sleep was poor after late screen use, concentration was better after walking, neck pain decreased after stretching and mood improved after group activity, then physical culture becomes personally meaningful. This method also supports self-efficacy because students see that their actions can change their condition. Social interaction deserves separate attention. Digital communication can create permanent contact without genuine closeness. Physical culture offers a rare space of non-digital cooperation in the university schedule. In team games and paired exercises, students read facial expressions, coordinate movement, support each other and experience shared effort. This may reduce loneliness and emotional tension. However, the teacher must prevent aggressive competition and ridicule. Inclusive methodology is essential. Physical culture should not reproduce social hierarchy based on athletic ability; it should create conditions where every student can experience progress. The model may also be relevant for students of physical culture as future professionals. They will work with children, adolescents, athletes or adult populations whose lives are already affected by digital devices. Therefore, their professional competence must include the ability to diagnose movement deficit, design active breaks, teach posture culture, connect physical activity with mental well-being and explain digital hygiene in simple terms. A specialist who understands only sport technique but ignores digital lifestyle risks will be methodologically incomplete. The limitations of the model must be recognized. First, physical culture cannot solve all psychological problems. Students with severe anxiety, depression, sleep disorders or addictive behavior may need professional psychological or medical assistance. Physical culture is preventive and supportive, not a replacement for clinical help. Second, the effect of physical activity

depends on the quality of implementation. A poorly organized lesson can increase stress, cause injury or reduce motivation. Third, the university environment must support the model. If timetables leave no breaks, sports facilities are inaccessible and teachers are overloaded, the model will remain formal. Fourth, digital fatigue is influenced by family stress, economic pressure, academic workload and personal traits, so movement is one important factor among several. Nevertheless, these limitations do not weaken the central thesis. They show that physical culture should be integrated into a broader system of student well-being that includes psychological support, rational academic workload, digital literacy and healthy campus design. In practical terms, universities can begin with simple steps: include active breaks in long lectures, organize walking routes on campus, recommend movement pauses during online classes, train teachers to recognize signs of digital fatigue, create student challenges focused on regular activity rather than elite performance, and add short modules on digital hygiene to physical culture classes. These measures are inexpensive, realistic and culturally adaptable. The paradox of the digital era is that the more education moves into screens, the more important it becomes to protect the body. This paradox should not surprise us. The brain may enjoy fast internet, but the spine still votes for movement.

Conclusion

The article has justified structured physical culture as a psychophysiological and pedagogical strategy for reducing digital fatigue among university students. Digital fatigue develops when prolonged screen exposure, sedentary behavior, attention fragmentation and insufficient recovery become a stable lifestyle pattern. Its symptoms are cognitive, emotional, physical and behavioral, which means that its prevention must also be multidimensional. Physical culture can reduce the consequences of digital overload through compensatory motor activation, regulation of the nervous system, social interaction and reflective self-monitoring. The proposed model includes four interconnected components: motor activation, psychophysiological recovery, digital-hygienic education and reflective self-monitoring. This model expands the traditional understanding of university physical culture. It does not reject sport technique, fitness or normative assessment, but supplements them with the aim of digital-era health preservation. The practical value of the model lies in its accessibility. It can be implemented through regular classes, independent walking or mobility sessions, daily active breaks and weekly self-assessment. It does not require expensive equipment, but it requires methodological awareness from the teacher and conscious participation from students. The main recommendation is that universities should integrate physical culture into student digital well-being strategies. Physical culture teachers should help students understand the relationship between screen habits, movement, sleep, mood and learning capacity. Students should be taught to use movement not only for physical development, but also for restoring attention, reducing emotional tension and building responsible

digital behavior. Future research should test the model empirically in university groups by measuring changes in perceived digital fatigue, physical activity level, sleep quality, posture complaints, mood, attention stability and academic self-efficacy before and after a structured intervention. The general conclusion is that in the digital world, physical culture becomes a form of mental protection. A university that teaches students to move consciously also teaches them to learn more sustainably, recover more intelligently and live with technology rather than under it.

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