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DYNAMICS OF MENTAL PERFORMANCE OF FIRST-YEAR STUDENTS AT THE SCHOOL OF MATHEMATICS AND NATURAL SCIENCES OF KOZYBAYEV UNIVERSITY

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Abstract

Studying at a university is challenging for students, often accompanied by emotional overload. Modern students experience low physical activity levels, which affect their mental performance. Additionally, they tend to experience increased fatigue, and deteriorating cognitive processes, memory, and attention, leading to impaired body functions and weakened immunity. It is crucial to maintain students' health throughout their university education. A graduate should not only possess solid knowledge but also be in excellent health to support creative endeavors throughout life. To preserve and enhance health, students must be taught how to properly organize their daily routines from the very first days at university. The most important place in the daily routine should be given to physical education and physical activity. Numerous studies have confirmed that physical activity positively affects the entire body's functional processes, particularly mental performance. During the day, it is essential to alternate between mental and physical activities. A well-structured class schedule, taking into account the dynamics of performance changes throughout the day and week, is also of great importance. This article analyzes changes in mental performance among first-year students during their educational process and offers recommendations to enhance their efficiency.

Keywords: body, health, immunity, performance, productivity, mental development, students, endurance, stress, fatigue, adaptation, physical activity, educational process, workload.

«М. ҚОЗЫБАЕВ СҚУ» КЕАҚ МАТЕМАТИКА ЖӘНЕ ЖАРАТЫЛЫСТАНУ ҒЫЛЫМДАРЫ ФАКУЛЬТЕТІНІҢ І КУРС СТУДЕНТТЕРІНІҢ ЖҰМЫС ҚАБІЛЕТТІЛІГІНІҢ ДИНАМИКАСЫ

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Андапта

Университетте Оқу-бұл эмоционалды жүктемелермен бірге жүретін студенттер үшін өте күрделі процесс. Қазіргі студенттерде оқу процесі төмен қозғалыс белсенділігі жағдайында жүреді, бұл олардың ақыл-ой қабілетіне әсер етеді, сонымен қатар шаршау жоғарылайды, ойлау процестері, есте сақтау, зейін нашарлайды, нәтижесінде дененің функционалдық көрсеткіштері бұзылады, иммунитет төмендейді. Университетте оқудың барлық кезеңінде студенттің денсаулығын сақтау маңызды. Ең бастысы, түлек жақсы білімге ие болып қана қоймай, сонымен қатар өмір процесінде одан әрі шығармашылық қызмет үшін денсаулығы жақсы. Денсаулықты сақтау және арттыру үшін студенттерге университетте оқудың

алғашқы күндерінен бастап өмір салтын, атап айтқанда күн тәртібін дұрыс ұйымдастыруға үйрету қажет. Күн тәртібіндегі ең маңызды орын дене шынықтыруға, қозғалыс белсенділігіне бөлінуі керек. Көптеген зерттеулердің негізінде физикалық белсенділік бүкіл ағзаның функционалдық процестеріне, атап айтқанда, ақыл-ой жұмысына оң әсер ететіндігі дәлелденді. Күні бойы іс - әрекеттерді өзгерту маңызды-ақыл-ой және физикалық. Жұмыс қабілеттілігінің өзгеру динамикасын ескере отырып, күн ішінде және апта ішінде оқу сабақтарының дұрыс кестесі де маңызды. Бұл мақалада бірінші курс студенттерінің оқу-білім беру процесінде ақыл-ой қабілетінің өзгеруіне талдау жасалады. Бірінші курс студенттерінің өнімділігін арттыру мақсатында ұсыныстар ұсынылды.

Кілт сөздер: дене, денсаулық, иммунитет, өнімділік, өнімділік, ақыл-ой дамуы, студенттер, төзімділік, шиеленіс, шаршау, бейімделу, физикалық белсенділік, оқу процесі, жүктеме.

ДИНАМИКА РАБОТОСПОСОБНОСТИ СТУДЕНТОВ I КУРСА ФАКУЛЬТЕТА МАТЕМАТИКИ И ЕСТЕСТВЕННЫХ НАУК НАО «СКУ ИМ. М. КОЗЫБАЕВА»

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Аннотация

Обучение в вузе достаточно сложный процесс для студентов, сопровождающийся эмоциональными перегрузками. У современных студентов процесс обучения протекает в условиях низкой двигательной активности, что отражается на их умственной работоспособности, кроме того наблюдается повышенная утомляемость, ухудшаются мыслительные процессы, память, внимание и, как следствие, нарушаются функциональные показатели организма, снижается иммунитет. Важно поддержать здоровье студента на протяжении всего периода обучения в вузе. Главное, чтобы выпускник имел не только хорошие знания, но и отменное здоровье, для дальнейшей творческой деятельности в процессе жизни. Чтобы сохранить и приумножить здоровье необходимо студентов с первых дней обучения в вузе учить правильно организовывать свой образ жизни, в частности - режим дня. Самое главное место в распорядке дня должно отводиться физической культуре, двигательной активности. На основании многочисленных исследований доказано, что физическая активность оказывает положительное влияние на функциональные процессы всего организма и в частности, на умственную работоспособность. В течение дня важно менять виды деятельности - умственную и физическую. Немаловажное значение имеет и правильно составленное расписание учебных занятий в течение дня и в течение недели, с учетом динамики изменения работоспособности. В данной статье проводится анализ изменения умственной работоспособности в учебно-образовательном процессе студентов первого курса. Предложены рекомендации с целью повышения работоспособности студентов первого курса.

Ключевые слова: организм, здоровье, иммунитет, работоспособность, продуктивность, умственное развитие, студенты, выносливость, напряжение, утомление, адаптация, физическая активность, учебно-образовательный процесс, нагрузка.

Introduction

At present, significant attention is given to studying the adequacy of the learning process and studentsə health, as well as the physiological changes that occur in their bodies under the influence of intellectual and emotional stress associated with studying, particularly in the first year.

Students' performance is a key criterion for their adaptation to academic workload. Numerous studies [1] research students' mental performance in relation to their academic load. However, the issue of students' adaptation to various influences, especially to academic workloads throughout the day, week, and academic year, remains insufficiently studied [2].

Performance is defined as the level of an organism's functional capabilities, characterized by the efficiency of tasks performed over a certain period of time [3].

Performance is classified into two types: physical and mental.

Mental performance refers to the amount of work requiring significant concentration of the nervous and psychological systems [4].

Physical performance is a person's ability to perform the maximum possible amount of physical work through the activation of the musculoskeletal system [5].

University education is a clear example of mental workload, as it involves receiving and processing large amounts of information. This process engages key psychological functions such as memory, attention, and thinking. Information is processed, absorbed, and later applied in practice, with the sensory system playing a crucial role. These workloads lead to overstrain of the brain and rapid fatigue. After a short period, students become less capable of absorbing the learning content. All these factors are further exacerbated by students' low physical activity [6]. Cognitive processes are largely determined by the physical fitness of a developing body. Numerous studies confirm that mental and physical development are closely interconnected [7].

Based on this, our study aimed to examine the mental performance of first-year students at the School of Mathematics and Natural Sciences of Kozybayev University.

Objective: To analyze changes in specific indicators of mental performance among first-year students at the School of Mathematics and Natural Sciences of Kozybayev University during different periods of the academic year.

Materials and Methods

The study was conducted over one academic year on the same group of first-year students. A total of 40 students (20 males and 20 females), aged 17-18 years, from the School of Mathematics and Natural Sciences participated in the research.

The collected data were processed using standard statistical methods, including the calculation of the following values: the arithmetic mean of the variation series, standard error of the mean, and mean root square deviation.

Currently, mental performance studies widely utilize letter-based correction tests, commonly known as Anfimov Tables. These tables help examine attention patterns when exposed to repetitive stimuli, such as letters. The varied distribution of identical letters within the rows prevents memorization and requires sustained concentration.

The analysis of performance included both qualitative and quantitative aspects of attention accuracy assessed within a set time frame. When analyzing the data, the following were counted: the total number of letters scanned, reflecting task completion speed and volume; the number of correctly identified and crossed-out letters within the total scanned volume; and the number of errors (missed letters).

Pre-prepared test sheets were distributed for the correction test. Prior to the experiment, students were given a briefing on the purpose of the study and its significance in assessing mental performance.

The students were familiarized with the letter tables and the test rules. Instructions before the task included:

1. Goal: complete the task as accurately and quickly as possible by crossing out the designated letter.
2. Guidelines: work with focus, avoid missing or incorrectly crossing out letters, and do not skip rows.

The Anfimov Test duration was five minutes, divided into five intervals with ten-second breaks between them. A stopwatch was used to track the work time, starting immediately after the letter was announced. The data analysis focused on the ratio of the total number of marked symbols to the total number of scanned symbols during the test period. Students completed the task independently and strictly on an individual basis.

Commonly Used Mental Performance Assessment Methods

1. *Accuracy Coefficient* **(A)**:

$A = M / N$;

where:

M is the number of correctly crossed-out symbols,

N is the total number of target symbols that should have been marked.

2. *Mental Productivity Coefficient* **(P)**:

$P = A * S$;

where:

S is the total number of symbols scanned,

A is the accuracy coefficient.

The quantitative indicators of accuracy and mental productivity coefficients are used to assess attention concentration (in relative units).

3. *Visual Information Volume* **(Q)**:

$Q = 0{,}5936 * S$;

where:

Q is the visual information volume (bits),

0.5936 is the average information volume per symbol,

S is the total number of scanned symbols.

4. *Information Processing Speed* **(V)**:

$V = (Q - 2{,}807 * h) / T$;

where:

V is the information processing speed (bits/sec),

2.807 bits is the information loss per missed symbol,

h is the number of errors,

T is the task completion time (seconds) [2].

Results

Based on the conducted experiment, it was revealed that mental performance, which indicates the degree of adaptation of first-year students to the learning process, fluctuates unevenly across days, weeks, and throughout the semester.

The study showed that cognitive processes among first-year male students declined throughout the school day. Thus, the accuracy coefficient of task completion ranged from 0.97 units to 0.85 units during the first class (with an average value of 0.91 units).

By the end of the school day, the accuracy coefficient decreased, ranging between 0.83 units and 0.75 units (with an average value of 0.79 units).

The mental productivity coefficient also fluctuated from 429 units to 316 units (average: 372 units) during the morning session and from 344.8 units to 225.2 units (average: 284 units) by the end of the day.

Similar results in mental performance were observed in female students. Morning accuracy coefficient ranged from 0.93 units to 0.78 units (average: 0.85 units), while late in the day it varied from 0.76 units to 0.68 units (average: 0.72 units).

The mental productivity coefficient for female students changed from 410 units to 298 units (average: 354 units) in the morning session to 335 units to 219 units (average: 277 units) at the end of the day.

According to literature references, mental performance changes throughout the week being low at the beginning, peaking around mid-week, and declining towards the end of the week [8].

In our study, students' mental performance was analyzed at the start of the semester over a full workweek and showed the following results: in male students, a gradual increase in accuracy coefficient was observed from Monday to Wednesday, peaking at 0.81 units on Wednesday; a decline followed on Thursday and Friday, reaching a minimum of 0.76 units; a slight recovery was noted by Saturday, with accuracy rising to 0.78 units.

In female students, the accuracy remained constant from Monday to Wednesday showing a slight increase on Thursday (0.81 units) and then a decrease on Friday (0.75 units). By Saturday, the accuracy coefficient experienced recovery at 0.77 units.

The mental productivity coefficient during the school week followed a similar pattern. Here, male students showed a peak on Wednesday with 437 units followed by a decline on Thursday (357 units) and a slight recovery on Friday (364 units). The indicators of female students' mental productivity are also comparable to the accuracy of task performance. Mental productivity remains stable over the first three days of the school week, with an increase occurring on the fourth day (maximum coefficient value of 374 units). This is followed by a decline in mental productivity (minimum coefficient value of 257 units) and then a rise again by Friday (323 units).

Our study identified disruptions in students' mental performance dynamics throughout the week.

According to the literature, class schedules should be structured so that the heaviest workload falls on Tuesdays and Wednesdays when performance is at its peak [9].

However, an analysis of the students' class schedules revealed that this principle was not followed.

As a result, poorly structured timetables negatively impacted students' mental performance.

Table 1. Comparison of First-Year Male and Female Students' Performance

Male Students	A (units)	P (units)	Q (bits)	V (bits/sec)	Female Students	A (units)	P (units)	Q (bits)	V (bits/sec)
	0,92	373,7	241,7	3,79		0,79	274,15	207,61	3,47

This study was conducted as a one-time assessment of first-year students' mental performance.

The obtained parameters for assessing the mental performance of first-year students lead to the conclusion that the task accuracy coefficient and the mental productivity coefficient are significantly higher in male students than in female students.

An analysis of individual performance indicators shows that by the end of the academic year, the number of cases of decreased performance increases unevenly. The percentage of students experiencing a decline in overall performance indicators reached 11% by the end of the first semester and 15% by the end of the second semester among male students. Among female students, this percentage was higher, reaching 14% by the end of the first semester and

17% by the end of the second semester. These data indicate different levels of fatigue among students.

Analyzing the changes in performance throughout the academic year, it can be noted that at the beginning of studies, performance increases, reaches its highest levels after about a month, and remains at this level for some time. However, during the exams, performance declines and reaches low levels. Students restore their performance during vacations.

At the start of a new semester, the performance change pattern repeats itself. By the end of the academic year, performance drops to its lowest levels. Summer break helps students restore their vitality and energy. Thus, it can be concluded that the dynamics of performance changes follow a cyclical pattern.

Discussion

Based on observations and student surveys, it can be concluded that academic activities involve high mental loads and stress, which in turn affect students' overall health. However, mental performance is essential for learning and directly impacts academic success. Physical activity is a unique tool for adapting the younger generation's bodies to the intense and mentally demanding educational process [10]. To enhance mental performance during exams, it is crucial for students to increase their physical activity levels. Changing activities throughout the day helps build "immunity" against fatigue and exhaustion, improves work efficiency, and, as a result, boosts academic performance. Most importantly, it supports overall health.

Physical education and sports can help restore the functional state of organs and body systems.

With low physical activity and high academic loads, students are at risk of developing various health issues, primarily nervous system disorders (neuroses), which in turn negatively impact the cardiovascular, respiratory, and digestive systems.

Conclusion

The educational process at a higher education institution is highly demanding, requiring intensive effort throughout the entire study. This greatly affects students' mental well-being, functional state, and overall performance. Moving to a new place, changing their lifestyle, and adjusting to a new routine are stressful factors. Students are especially vulnerable to these changes, which increase the risk of physical and mental overload.

It is important to note that learning takes place under conditions of low physical activity, leading to inhibition processes in the brain. As a result, fatigue develops, performance declines, and overall well-being deteriorates. This is particularly dangerous for the developing body of students. The immune system function is disrupted, and adaptation to academic activities becomes more difficult.

To relieve mental strain, physical exercise is essential, as it provides a change in activity type. In this study, 66% of students experienced a static workload, meaning their biological need for movement was not met. The number of hours allocated to physical education classes in the curriculum is insufficient to relieve this static tension.

To improve academic performance, the authors recommend students establish a well-structured daily routine, increase physical activity, and attend additional extracurricular sports sections if possible. These actions will reduce emotional stress, enhance overall performance, and facilitate better knowledge retention.

I.M. Sechenov's principle states that alternating muscle activity between different muscle groups promotes recovery more effectively than complete inactivity. This principle is the foundation for organizing breaks in intellectual work.

Properly structured physical exercise combined with mental work provides significant benefits in maintaining cognitive function and productivity [11].

It is crucial for students to engage in daily physical activity and develop a habit of maintaining an active lifestyle.

When performing physical exercises, a “dominant excitation” occurs in the brain, which positively affects the body’s overall functional state. This leads to improved cardiovascular and respiratory function, better cerebral blood circulation, reduced stress impact on the body, increased body tone, and accelerated recovery processes. In summary, alternating activity types throughout the day is essential for restoring performance and improving academic success [12].

However, physical activity and sports alone do not guarantee high academic performance. Other factors must also be considered, including a well-organized study and rest schedule, adequate sleep, proper nutrition, and optimization of the learning process.

University administrators must develop academic schedules that consider fluctuations in students’ cognitive performance. The heaviest workload, taking into account the number and difficulty of classes, should be scheduled for Tuesdays and Wednesdays. This will contribute to better learning outcomes and help maintain students’ health.

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