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THE ARTISTIC POTENTIAL OF INTEGRATIVE BIONICS AS A RESOURCE FOR SUPPORTING AND DEVELOPING THE CREATIVITY OF HIGHER EDUCATION STUDENTS

***Abstract. The purpose** of the article is to attract attention to the approach to determining the artistic potential of integrative bionics as a resource for supporting and developing the creativity of higher education students (on the examples* *of teaching in medical and artistic institutions). **The research methodology** is the introduction of knowledge in integrative bionics with the development of an appropriate philosophical paradigm based on systematization and comparative analysis of the impact of its teaching based on the principles of general systems theory. **The scientific novelty** of the work is that for the first time the philosophical paradigm of integrative bionics is applied as a means of interdisciplinary integration of knowledge in the training of specialists.*

Conclusions. *The potential of integrative bionics is determined by a reliably stable improvement in the performance of higher education students, increasing their motivation to master knowledge from the large information flows of our time. The effectiveness of the implementation of knowledge in integrative bionics is associated with a student-centered approach to learning in combination with the humanistic component of art and the resource of a positive psychological microclimate. The use of the philosophical paradigm of integrative bionics as a means of interdisciplinary integration of knowledge through visual perception of the wonder of the world opens up new horizons for a deeper study of educational components in both medical and art education.*

***Key words**: higher education, integrative bionics, creativity, artistic potential.*

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МИСТЕЦЬКИЙ ПОТЕНЦІАЛ ІНТЕГРАТИВНОЇ БІОНІКИ ЯК РЕСУРС ПІДТРИМКИ Й РОЗВИТКУ КРЕАТИВНОСТІ ЗДОБУВАЧІВ ВИЩОЇ ОСВІТИ

Анотація. Метою *статті є привернення уваги до підходу з визначення мистецького потенціалу інтегративної біоніки* ***як ресурсу*** *підтримки й розвитку креативності* ***здобувачів вищої освіти (на прикладах викладання у медичному і мистецькому закладах). Методологія дослідження*** *– впровадження знань з інтегративної біоніки із розвитком відповідної філософської парадигми на основі сиситематизації та порівняльного аналізу впливу її викладання за принципами загальної теорії систем.* ***Наукова новизна*** *роботи полягає в тому, що вперше застосовано філософську парадигму інтегративної біоніки як засіб міждисциплінарної інтеграції знань при підготовці спеціалістів.* ***Висновки****. Потенціал інтегративної біоніки визначається достовірно стабільним покращенням успішності здобувачів вищої освіти, підвищенням їх мотивації до опанування знань із великих інформаційних потоків сучасності. Ефективність впровадження знань з інтегративної біоніки пов'язана із студентоцентричним підходом до навчання у поєднанні з гуманістичною складовою частино мистецтва та ресурсом позитивного психологічного мікроклімату. Використання філософської парадигми інтегративної біоніки як засобу міждисциплінарної інтеграції знань через візуальне сприйняття дивовижності світу відкриває нові горизонти більш глибокого вивчення освітніх компонентів як у медичній освіті, так і в освіті мистецького напряму.*

Ключові слова*: вища освіта, інтегративна біоніка, креативність, мистецький потенціал.*

Formulation of the problem. Harmonization of the body's state is impossible without unity with the natural environment, of which the human being remains a part at all times. In ancient times and during the Renaissance, the human body was considered the ideal of beauty. As early as the fifth century BC, the sculptor Polycletus of Argos explained the proportions he had defined. In the 15th century, the genius Leonardo da Vinci proved that the human body is beautiful because it complies with the laws of symmetry and the principle of the golden ratio. In the XX century, the ideals of human body proportions were revised approximately every 15–20 years. During this turbulent period in human history, ideas about beauty changed significantly. However, the statement that the human body is beautiful remained unchanged.

The placement of balanced and clear forms of architecture among the landscape, comfortably arranged to achieve unity and mutual complementation of natural and man-manufactured things, has become the content of classical compositions, the center and measure of which remains the human being. And serving him is the vocation of such creative fields as medicine and architecture.

In today's conditions, medical science has a large arsenal of rehabilitation methods, among which landscape therapy rightfully occupies a special place and is actively used [5]. And in architectural science, bionics has emerged and taken its rightful place [8].

However, the challenges of the XXI century with the digitalization of society, the increasing pace of life on the one hand and the acceleration of alienation in human society on the other, have led to the need to find compromise solutions, the "golden mean" of adaptive capabilities in all spheres of human activity, to increase these capabilities and maintain them at a high level of individual functioning. The training of higher education students in such conditions is no exception. The issues of conveying new necessary knowledge in large flows of information, ways of communicating with students, motivational technologies are widely discussed in the circles of the scientific pedagogical community [1; 6], as well as by practitioners in training specialists [3].

Analysis of sources and recent research. An interesting direction for the development of the concept of training a worthy specialist may be the use of scientific discoveries, in particular in the field of digital technologies, both in the process of acquiring knowledge, developing analytical thinking and creativity in the context of integrative and interdisciplinary connections, and in supporting the resources and adaptive capabilities of a modern higher education student.

Digital technologies have made it possible to discover that the all-encompassing principle of the golden ratio is also represented at the microscopic level. For example, the DNA helix is 34 angstroms long and 21 angstroms wide, and the ratio of these two parameters is 1:1.618, which is the value of the golden ratio. The peculiarity of the bronchi is their asymmetry: the left main bronchus is longer, the right one is shorter. It was found that this asymmetry is also observed in the branching of the bronchi of the following orders, up to the terminal bronchioles. In addition, the ratio of the length of the shorter to the longer ones also corresponds to the value of the golden ratio and is equal to 1:1.618. The cochlea of the inner ear demonstrates harmony because it has a shell shape that corresponds to a logarithmic spiral [4, p. 109].

On the other hand, today there are many artists and designers who are fascinated by the discovery of ultrastructural histological science. Expressive images of cells and organs become interior decorations, inspire the creation of prints of tissues, porcelain, manicures, phone cases, etc. [2; 9]. In this way, bionics at the microscopic level not only reunites medical and architectural science in the modern world, but also allows for the integration of interdisciplinary knowledge, makes the education process interesting and creative, and inspires the search for the deep potential of such a non-manufactured art. The center of which is a person in all his or her diversity.

The purpose of the study is to determine the artistic potential of integrative bionics as a resource for supporting and developing the creativity of higher education students.

Presenting main material. The methodology for introducing knowledge of integrative bionics in practical classes in histology and internal medicine in junior and senior years at medical universities and in practical classes in the process of training designers was tested in three groups of higher education students. The first group consisted of 30 2nd year medical students who studied the educational component “Histology, Cytology and Embryology”, the second group consisted of 30 6th year medical students who studied the educational component “Internal Medicine”, and the third group consisted of 15 4th year design students. The comparison groups, which were representative in terms of number, age, gender, and level of training at the baseline, included students of the same educational institutions, courses, and years of study, whose practical classes on the same educational components were held without the use of this methodology. Students’ success was analyzed at the beginning and at the end of the educational component. For students of medical universities, we also analyzed their success in passing the integrated Krok-1 exam in the junior year and Krok-2 in the senior year.

Data analysis was performed in SPSS Statistics v.23. Summary statistics of mean, standard deviation and percentiles were used for quantitative measurements.

The probability value was estimated at 0.05 confidence level (P=0.05).

The average score of the 2nd year students at the beginning of the educational component “Histology, Cytology and Embryology” was 3.56, and in the comparison group – 3.69. After completing the study of histology with the introduction of knowledge of integrative bionics, the average score of students in this group increased significantly and was equal to 4.42 ($p<0.05$). In the comparison group, there was an increase in the average score to 3.82, but the improvement in academic performance was not significant. The analysis of the success rate of the integrated exam “Krok-1” in the profile “Histology” showed a significantly higher percentage of successful completion in the group whose practical classes used the methodology (81.9%) compared to the group whose practical classes were held without its use (68.9%) ($p<0.05$). Upon completion of the educational component “Histology Cytology and Embryology”, students of the group that studied using knowledge of integrative bionics noted an increase in motivation to obtain higher medical education, broadening of the worldview, improvement of memory and associative thinking, a desire to engage in student science and work in a student scientific community, and the creation of their own analytical projects.

The average score of the 6th year students at the beginning of the study of the educational component “Internal Medicine” was 3.8, in the comparison group of the same course – 3.83. Upon completion of the study of internal medicine with the introduction of knowledge of integrative bionics, the average score of students in this group increased significantly and was equal to 4.4 ($p<0.05$). The comparison group showed an increase in the average score of this educational component to 4.0, but the improvement in performance was not significant. As a separate positive component of the classes using the innovative approach, students noted an increase in their cognitive abilities, motivation for continuing education, interest in solving clinical problems, and an increase in general erudition. The analysis of the success rate of the integrated exam "Krok-2" in the specialty "Internal Medicine" revealed a significantly higher percentage of successful completion in the group in which the methodology was used in practical classes (85.3%) compared to the group in which practical classes were held without the use of the methodology (70.9%) ($p<0.05$).

The reduced (to a 5-point scale) average score of 4th year design students at the beginning of the academic year at the academy was 3.9 in the group that used the methodology for implementing knowledge of integrative bionics, and 3.95 in the group without using this approach in teaching. The reduced average score of final qualification works in the group of design students who used knowledge of integrative bionics was 4.5 and was significantly higher ($p<0.05$) compared to the reduced average score of final qualification works in the group of design students who did not study the features of integrative bionics in practical classes – 4.2. Compared to the second group, the diploma works of the first group were characterized by more refined color solutions and a more detailed elaboration of the forms of design composition, which were distinguished by originality, extraordinary approaches and morphological innovation.

In the eighteenth century, the prominent microscopist Marcello Malpighi, who discovered capillaries, studied in detail the fine structure of the skin, spleen, kidney, and other organs, wrote: "It is our firm opinion that the anatomy of extremely small structures of internal organs, which is relevant at this time, is not needed by any doctor" [7, p. 309]. Today, for four centuries in a row, modern histological science not only describes the morphological substrate, but also, using modern research methods (electron microscopy, immunohistochemistry, polymerase chain reaction, etc.), demonstrates functional apparatus at the subcellular level, thereby laying the foundation for understanding the function of cells, tissues and organs in general. This knowledge is necessary in order to further understand what and how is damaged in pathology, and what mechanisms exist to restore the affected structures. Without knowledge in this area, it is impossible to proceed to the study of clinical disciplines. A deep understanding of the mechanisms of the microcosm and their morphological substrate underlies the development of the latest technologies for the diagnosis, treatment and prevention of diseases.

A modern doctor must be equipped with this knowledge because he uses the latest methods in his practice. Most patients want to understand what is happening to them and why they are being treated in the way they are. The ability of a doctor to clearly and correctly explain what changes are taking place in a diseased organism at the cellular and tissue level, what will change in the structure and function of the cells themselves if certain medications are used, can be one of the factors of psychological support for the patient and help to increase trust in the doctor. Today's practical medicine is replete with such examples [10], and we use them in our practical classes in internal medicine. When prescribing a proton pump inhibitor, a doctor must clearly know what a proton pump is and explain the mechanism of its operation. Without knowledge of the insulin receptor (membrane integral protein) and glucose transporters, it is impossible to explain to a patient with newly diagnosed type 2 diabetes mellitus the mechanism of hyperglycemia in the presence of normal or elevated blood insulin levels. It is also impossible to explain to a patient the essence of diagnosing myocardial infarction by determining the presence of troponin in the blood, which is now a routine rapid method, without knowledge of the place of this protein in the work of the heart muscle. Specialists in such surgical specialties as ophthalmologist, neurosurgeon, vascular surgeon, and otolaryngologist use a microscope in their work, and thus operate at the tissue level. A doctor who wants to achieve significant success in his or her profession realizes the need to know the basic structure and functioning of organs. Understanding this comes with experience, and experience is the result of natural curiosity and many years of work. In addition, it should be remembered that the amount of information about the microscopic and submicroscopic structure of cells and tissues doubles every five years.

Smooth lines, perfect shapes, appropriate sizes, and carefully arranged rationality of the microcosm's contents through the expansion of the arsenal of histochemistry, light, and later transmission and scanning electron microscopy methods can emotionally fascinate no less than a breathtaking picture of the starry sky. Thus, scientific discoveries in the microcosm gave rise to a visual perception of the miraculous in human life.

Such a philosophical paradigm of integrative bionics has the potential for a creative approach to mastering theoretical and clinical disciplines in medical universities, inspires the opening of new creative horizons for students of artistic universities, in particular in the field of design. The use of the approach of implementing knowledge of integrative bionics makes the learning process not only knowledge-intensive, motivated, but also easy for students due to the artistic resource of support and personal development.

Conclusions. The potential of integrative bionics is determined by a reliably stable improvement in the performance of higher education students, increasing their motivation to master knowledge from the vast information flows of our time.

The effectiveness of the implementation of knowledge in integrative bionics is associated with a student-centered approach to learning in combination with the humanistic component of art and the resource of a positive psychological microclimate.

The use of the philosophical paradigm of integrative bionics as a means of interdisciplinary integration of knowledge through visual perception of the wonder of the world opens up new horizons for a deeper study of educational components in both medical and art education.

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