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Formalization of the Process of Formation of bachelor's Competencies «Biomedical Engineering» and Evaluation of Its Quality

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ABSTRACT

Background. Medical engineering combines the design and problem-solving skills of engineering, medical and biological sciences to improve health care, including diagnosis, monitoring, and therapies based on fundamental principles of molecular and cellular biology. For successful learning (mastering) of the necessary knowledge, skills and competencies, and their implementation in practice, a flexible system of effective learning (study) of the relevant training modules is needed based on the development of their special computer knowledge base and database, using ideas and methods mathematical modelling and artificial intelligence. Given the above, it is of great interest to create a computer educational and methodological support for the integrated teaching of disciplines of general scientific departments and special disciplines in the training of specialists in "Biomedical Engineering".

Methods. It is known that the entire educational process in the university is subordinated to the formation of the competencies of the graduate specialist. In this regard, the urgent problem is the integration of the content of the studied disciplines, which contributes to the formation of the necessary professional competencies among students. In this regard, first of all, the general structural and functional scheme for the formation of competencies of the bachelor of "Biomedical Engineering" is considered. Secondly, a block diagram for determining the milestone knowledge, skills and abilities of students is considered. Thirdly, the structural form of the algorithm for determining milestone knowledge, skills and abilities and the formation of students' competencies for the implementation of complex professional interdisciplinary work is considered.

Conclusion. It seems to us that the approach we propose can form an essential basis for formalizing the process of forming the professional competencies of a bachelor - "Biomedical Engineering" and assessing its quality.

Keywords: biomedical engineering, knowledge, professional competence of students, skills, skills, general scientific and special disciplines, task-oriented interdisciplinary approach, self-study.

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INTRODUCTION

Medical engineering combines the design and problem-solving skills of engineering, medical and biological sciences to improve health care, including diagnosis, monitoring, and therapies based on fundamental principles of molecular and cellular biology.

For successful learning (mastering) of the necessary knowledge, skills and competencies, and their implementation in practice, a flexible system of effective learning (learning) of the relevant training modules is needed based on the development of their special computer knowledge base and database, using ideas and methods of mathematical modelling and artificial intelligence [1].

Given all the above, it is of great interest to create a computer educational and methodological support for teaching disciplines of general scientific departments and special disciplines in the training of specialists in "Biomedical Engineering".

It is known that the entire educational process in a university is subordinated to the formation of the competencies of a graduate specialist. In this regard, the urgent problem is the integration of the content of the studied disciplines, which contributes to the formation of the necessary professional competencies among students.

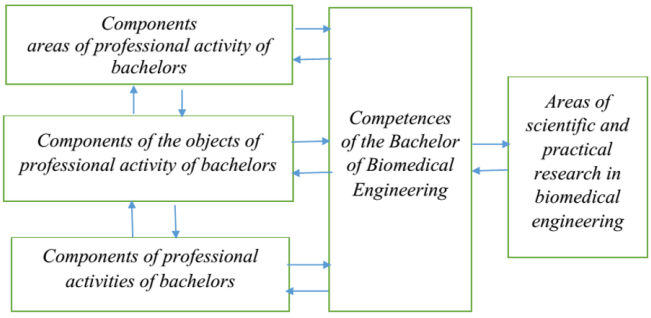
Integration is understood as the creation of fundamentally new educational information with the appropriate content of educational material, educational and methodological support, and new technologies. The integration of knowledge from various subjects is carried out with the help of integrated learning, which is understood as content and structurally coordinated teaching of various disciplines, aimed at identifying their interdisciplinary connections, as well as the specific properties of the subjects studied [2].

MATERIAL & METHODS

In connection with the above and considering [3], first, we will consider the general structural and functional scheme for the formation of competencies of a Bachelor of Biomedical Engineering, which can be represented as follows (see Scheme 1).

It should be noted that the formulations of the components of the field, objects, types of professional activities of bachelor, their competencies in accordance with educational standards, and curricula are of a directive nature.

Traditionally, knowledge assessment (K) is mainly the result of passing an exam in a discipline. The assessment of skills (S) is formed mainly in practical classes and when performing tests. Skill score (S) is accumulated during laboratory practice.

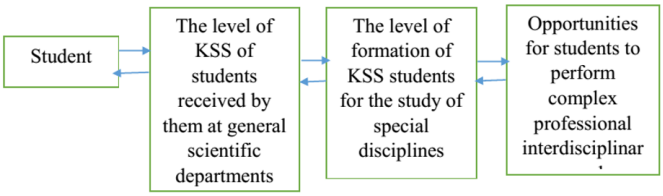


Scheme 1. General structural and functional scheme for the formation of competencies of the bachelor of "Biomedical Engineering"

KSS of students is evaluated based on the materials of the subject being studied, compiled in the form of test surveys. Determining the functional relationship between the requirements of policy documents and the results of test assessments is "not so simple".

The consideration of rather complex issues in integrated classes, the very specifics of the integration, naturally, require the constancy of the efforts of students aimed at achieving the set goals, studying, and applying various approaches to their implementation, solving and researching various options for getting out of problem situations depending on changing conditions [11].

According to [4], the block diagram for determining the staged KSS can be represented as (see Scheme 2).



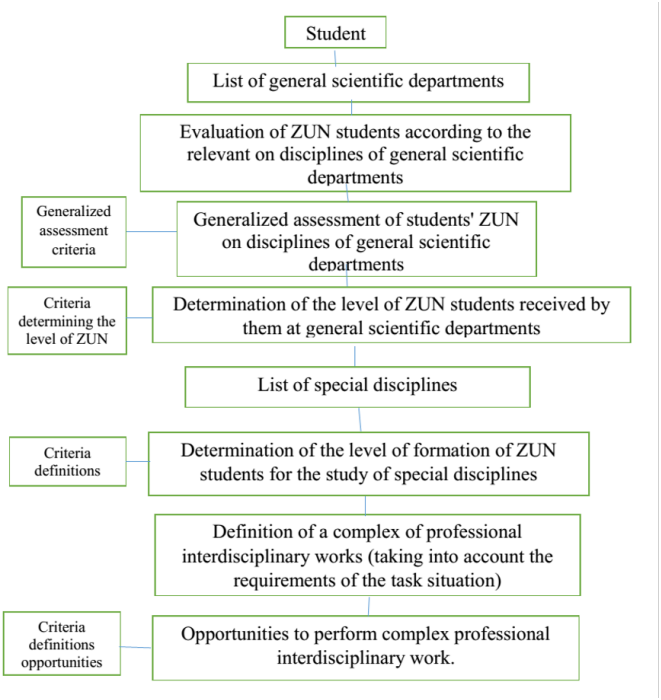
Scheme 2. Structural diagram for determining the stage KSS

At the same time, several questions arise, such as how to determine the level of KSS of students and their generalized assessment received by them in general scientific departments. How to determine the level of formation of ZUN students for the study of special disciplines? How to determine the possibilities for students to perform complex professional interdisciplinary work? The nature of knowledge of the disciplines of general scientific departments and special disciplines has its own specific character and varies greatly.

RESULTS

Summarizing the above, it is possible to draw up the following structural form of the algorithm for determining stage-by-stage KSS and forming stu-

dents' competencies to perform complex professional interdisciplinary work (see Scheme 3).



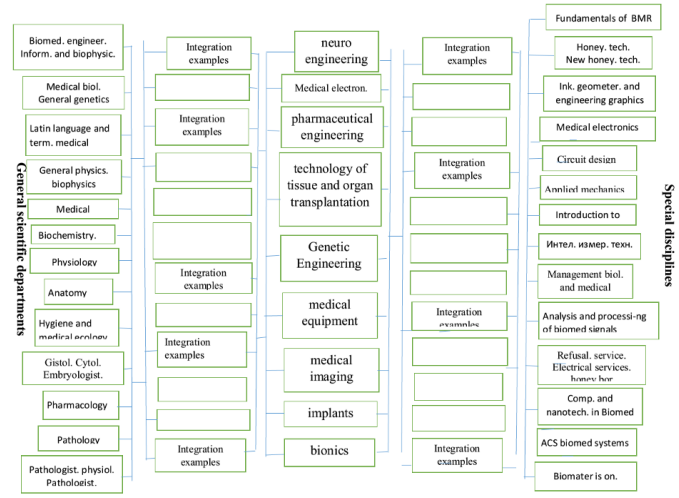
Scheme 3. Structural view of the algorithm for determining the milestone and the formation of students' competencies for the implementation of complex professional interdisciplinary work.

It should be noted that to determine the possibilities of performing complex professional interdisciplinary work, computer information, and medical and technological support are needed. Further, we offer a variant of such a provision.

In view of the foregoing and, as it seems to us, for the successful formation of students' skills in designing and solving problems in engineering, medical, and biological sciences, we propose the following structural and functional scheme for compiling a knowledge base and a database of a system for integrating disciplines studied by them in general scientific departments and special disciplines (see Scheme 4).

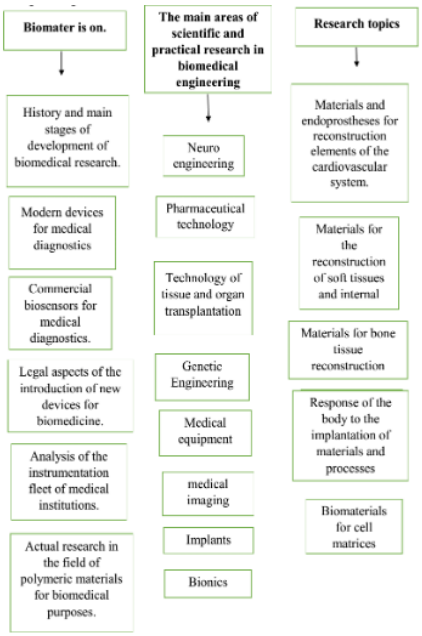
For each block of the research area of this scheme 4, examples of already implemented integrations with the disciplines of general scientific departments and special disciplines (from literary and Internet sources and own developments) are compiled. As a result, a base of integration systems will be compiled, based on which students will be able to get an idea about existing integration systems.

When considering a particular biomedical-technical problem, first, a suitable integration system will be determined from the existing database of integration systems. In the absence of a suitable integration system for the considered bio-medical-technical problem, on the basis of a research project, together with the relevant specialists, an appropriate new integration system will be compiled.



Scheme 4. Structural and functional diagram of an exemplary initial knowledge base and a database for the formation of competencies of bachelor of "Biomedical Engineering".

Based on the above methodological and theoretical ideas, today we have created an approximate initial knowledge base and a database for the formation of competencies of bachelor of «Biomedical Engineering» (see Scheme 5).



Cheme 5. Structural and functional diagram of an exemplary initial knowledge base and adatabase for the formation of competencies of bachelor of "Biomedical Engineering"

DISCUSSION

The problem of the formation of professional competencies of university students is considered in a number of works, for example [1-11 and many others. etc.].

As an example, let us cite the work [5], which defines a 3-stage system for acquiring strong professional competencies by students in the development of new products.

The first stage (2 courses) -

- choice of topic, (supervisor - teacher),
- substantiation of its relevance, (conducting a review and analysis of the literature on the research topic.) based on the results of the work,
- selection of a specific enterprise for the implementation of the results of work;

The second stage (3 courses) -

- development of the work program,
- carrying out preliminary studies (it is possible to manufacture a new product),
- substantiation of research methods, and preparation of reports (publications).

The third stage (4 courses) -

- development of specified quality indicators of a new product,
- development of regulatory documentation for the product,
- coordination with the base enterprise of the production volumes of the developed product,
- solution of issues related to the organization of production of the developed product at the base enterprise (selection of technological equipment, its placement on the site, etc.) and justification of the effectiveness of these works, preparation of materials for participation in conferences, publications in the open press,
- goals and objectives; (correct formulation of goals and objectives to achieve a specific goal).

In [9], the problem of integrating the content of education, which contributes to the formation of the necessary professional competencies in students, is considered. Integration is understood as the creation of fundamentally new educational information with the appropriate content of educational material, educational and methodological support, and new technologies. The integration of knowledge from various subjects is carried out with the help of integrated learning, which is understood as the content and structurally coordinated teaching of various disciplines, aimed at identifying their interdisciplinary connections, as well as the specific properties of the subjects being studied.

In [8] it is noted that interdisciplinary integration is implemented in different models of its implementation: - integration of disciplines included in the same educational field; - integration of disciplines included in different educational fields: this type of integration is carried out, for example, in the synthesis of natural sciences and the humanities curriculum; - integration based on the dominance of one of the disciplines, when others act as an additional auxiliary tool.

It is noted in [5] that the actual problem of higher education at the present stage is the practical implementation of the competency-based approach in training personnel for the economy, overcoming the existing contradictions between the requirements for the competencies of graduates from the state, employers, and the existing educational results. This problem is particularly acute in relation to the field of higher technical education since the level of development of the competencies of engineering personnel and the requirements for their activities are determined by the priority tasks of the country's economic development. This is to ensure the global competitiveness of domestic products, the technological re-equipment of industry, and a radical increase in labour productivity. The system of higher education, including technical education, is largely focused on the formation of theoretical subject knowledge and basic skills.

It is noted in [2] that an important condition for improving the quality of education is the introduction of a competency-based approach, which is associated with personality-oriented and effective approaches to education since it concerns the individual and can be implemented and verified only in the process of performing a particular work by a particular student. When defending a final qualification work, a university graduate must, demonstrate the possession of professional competencies, also show acquired personality traits, such as: - the ability to apply knowledge from various disciplines in professional activities; - confidence in their ability to solve the problems of professional activity, comprehensively applying knowledge from various disciplines; - readiness for self-study in the study of disciplines; - experience in the practical application of interdisciplinary tasks in future professional activities.

In [3], it is noted that competence is a broader and less defined concept. Being systemic, it includes knowledge, skills, and skills as non-linearly related components, relying on them as a lower, but basic level in the system hierarchy. In turn, competencies are components and stages of a "higher" and multidimensional systemic concept – "professionalism".

At the same time, competencies are evaluated, either directly related to the professional functions of specific activity of engineers, builders, teachers, etc. or revealing personal behavioural aspects. Assessments are often of a qualitative nature, determining not so much the results achieved, but the trends in the process of achieving them.

It seems to us that the above discussion indicates the correctness of the way we have chosen to implement the problem under study.

CONCLUSION

Currently, we are conducting research on the compilation of computer information and medical-technological support for schemes 3 and 4.

It seems to us that the above can form an essential basis for formalizing the process of forming the professional competencies of a bachelor - "Biomedical Engineering" and assessing its quality.

There is no funding.

The topic is proactive.

There are no conflicts of interest.

Ethical rules are followed.

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BAKALAVR KOMPETENSIYALARINI SHAKLLANTIRISH JARAYONINI RASMIYLASHTIRISH "BIOTIBBIYOT MUHANDISLIGI" VA UNING SIFATINI BAHOLASH

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ABSTRAKT

Dolzarbligi. Tibbiyot muhandisligi sog'liqni saqlashni yaxshilash, shu jumladan molekulyar va hujayrali biologiyaning asosiy tamoyillariga asoslangan diagnostika, monitoring va davolash usullarini yaxshilash uchun muhandislik, tibbiyot va biologiya fanlarining loyihalash va muammolarni hal qilish ko'nikmalarini birlashtiradi. Kerakli bilim, ko'nikma va malakalarni muvaffaqiyatli o'rganish (o'zlashtirish) va ularni amaliyotga joriy etish uchun tegishli o'quv modullarini ularning maxsus kompyuter bilimlari bazasi va ma'lumotlar bazasini rivojlantirish asosida samarali o'rganish (o'rganish)ning moslashuvchan tizimi zarur; g'oyalar va usullardan foydalanish matematik modellashtirish va sun'iy intellekt. Yuqoridagilarni inobatga olgan holda, "Biotibbiyot injeneriyasi" mutaxassisligi bo'yicha mutaxassislar tayyorlashda umumiy fan bo'limlari va maxsus fanlarni kompleks o'qitishning kompyuter o'quv-uslubiy ta'minotini yaratish katta qiziqish uyg'otadi.

Tadqiqotlar. Ma'lumki, universitetda butun o'quv jarayoni bitiruvchi mutaxassisning kompetensiyalarini shakllantirishga bo'ysunadi. Shu munosabat bilan o'rganilayotgan fanlar mazmunini integratsiyalashuvi dolzarb muammo bo'lib, bu talabalarda zarur kasbiy kompetensiyalarni shakllantirishga yordam beradi. Shu munosabat bilan, birinchi navbatda, "Biotibbiyot muhandisligi" bakalavriatining kompetensiyalarini shakllantirishning umumiy strukturaviy-funksional sxemasi ko'rib chiqiladi. Ikkinchidan, talabalarning bilim, ko'nikma va qobiliyatlarini aniqlash uchun blok-sxema ko'rib chiqiladi.

Xulosa. Bizningcha, biz taklif qilayotgan yondashuv bakalavrning kasbiy kompetensiyalarini shakllantirish jarayoni – "Biotibbiyot muhandisligi"ni rasmiylashtirish va uning sifatini baholash uchun muhim asos bo'lishi mumkindek tuyuladi.

Kalit so'zlar: biotibbiyot muhandisligi, talabalarning kasbiy kompetensiyasi, bilim, ko'nikma, malakalar, umumiy ilmiy va maxsus fanlar, vazifaga yo'naltirilgan fanlararo yondashuv, mustaqil ta'lim.

ФОРМАЛИЗАЦИИ ПРОЦЕССА ФОРМИРОВАНИЯ КОМПЕТЕНЦИЙ БАКАЛАВРА «БИОМЕДИЦИНСКОЙ ИНЖЕНЕРИИ» И ОЦЕНКИ ЕГО КАЧЕСТВА

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АБСТРАКТ

Актуальность. Медицинская инженерия сочетает в себе навыки проектирования и решения проблем инженерии, медицинских и биологических наук для улучшения здравоохранения, включая диагностику, мониторинг и методы лечения, основанные на фундаментальных принципах молекулярной и клеточной биологии. Для успешного обучения (освоения) необходимых знаний, умений, навыков и компетентностей, и их реализации в практической деятельности, необходима гибкая система эффективного обучения (изучения) соответствующих учебных модулей на базе разработки их специальной компьютерной базы знаний и базы данных, с использованием идей и методов математического моделирования и искусственного интеллекта.

Методы. Известно, что весь образовательный процесс в вузе подчинен формированию компетенций выпускаемого специалиста. В связи с этим, насущна проблема интеграция содержания изучаемых дисциплин, способствующая формированию у студентов необходимых профессиональных компетенций. В связи с этим, в первую очередь рассматривается общая структурно-функциональная схема формирования компетенций бакалавра «Биомедицинской инженерии». Во-вторую очередь рассматривается структурная схема определения этапных знаний, умений и навыков студентов. В— третью очередь, рассматривается структурный вид алгоритма определения этапных знаний, умений и навыков и формирования компетенций студентов для выполнения комплексных профессиональных междис-циплинарных работ.

Заключение. Как нам представляется, предлагаемый нами подход может составить существенную базу для формализации процесса формирования профессиональных компетенций бакалавра - «Биомедицинской инженерии» и оценки его качества.

Ключевые слова: профессиональная компетентность судентов, биомедицинская инженерия, знания, умения, навыки, общенаучные и специальные дисциплины, задачно-ориентированный междисциплинарный подход, самостоятельное обучение.