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ТЕОРЕТИЧЕСКИЕ ПРИНЦИПЫ РАЗРАБОТКИ СОДЕРЖАНИЯ КУРСА ФИЗИКИ В МЕДИЦИНСКОМ ВУЗЕ

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Аннотация. *Известно, что в федеральных государственных стандартах высшего медицинского образования не регламентируется содержание изучаемых студентами дисциплин, в том числе и физики. Обобщив опыт разработки содержания учебных дисциплин, имеющийся в педагогической науке и практике, авторы данной статьи пришли к выводу, что проблема формирования содержания курса физики в медицинском вузе остается не решенной: нет единства среди профессорско-преподавательского состава во мнении о тематическом представлении учебного материала, о глубине изучения физики будущими врачами и т.п. Отдельно отмечено, что содержание курса физики в медицинских вузах, как правило, одинаково для различных специальностей. Выявленные проблемы решаются авторами статьи в рамках реализации принципа фундаментальности обучения и принципа профессиональной направленности, компетентностного и деятельностного подходов. Так, сочетание данных дидактических принципов обеспечивает взаимосвязь фундаментальной и профессиональной составляющей обучения, а реализация выбранных подходов позволит учесть специфику будущей профессиональной деятельности. Используя данную теоретическую основу, разработан механизм (прием) формирования содержания учебного материала в виде системы действий, руководствуясь которыми может быть выявлено содержание курса физики для студентов медицинских вузов с учетом их будущей профессиональной деятельности. Данный механизм был применен для разработки содержания курса физики для будущих стоматологов и прошел апробацию в ряде российских медицинских вузов, получив положительную оценку профессорско-преподавательского состава профильных кафедр. Для подтверждения объективности оценки авторами исследования был применен метод экспертных оценок, результаты которого доказали эффективность предложенной системы действий по разработки содержания курса физики в медицинском вузе.*

Ключевые слова: *обучение физике будущих врачей, содержание курса физики в медицинском вузе.*

THEORETICAL PRINCIPLES OF DEVELOPING A PHYSICS COURSE IN A MEDICAL UNIVERSITY

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Abstract. *It is known that the content of the studied disciplines including physics isn't regulated by federal state standards of higher medical education. Having generalized the experience of pedagogical science and teaching training in developing the content of academic disciplines, the authors of the given article came to a conclusion that the problem of forming the content of physics course in a medical university remains unsolved: there is no unity of opinion among the teaching staff on the subject presentation of teaching material, on the depth of studying physics by future doctors. It is separately noted that the content of physics course in medical universities is as a rule the same for different majors. The revealed problems are solved by the authors of the article in the framework of implementing the principle of fundamentality of education and the professional orientation principle, competence and activity approaches. Thus, the combination of these didactic principles ensures the interconnection of the fundamental and professional component of training, and the implementation of the selected approaches will allow taking into account the specifics of future professional activity. Applying this theoretical basis, a mechanism (technique) was developed for the formation of the content of educational material in the form of a system of actions, guided by which the content of physics course for students of medical universities can be identified taking into account their future professional activity. The given mechanism was used to develop the content of physics course for future dentists and was tested in a number of Russian medical universities, receiving a positive evaluation from the teaching staff faculty of specialized departments. To confirm the objectivity of the evaluation, the authors of the study used the method of expert assessments, the results of which proved the effectiveness of the proposed system of actions for developing the content of physics course in a medical university.*

Keywords: *teaching physics to future doctors, the content of physics course in a medical university.*

Introduction

One of the controversial issues causing debate among the teaching staff is the question of the Federal educational standards implemented in the system of higher professional education. The authors of this article are not aimed at identifying the positive or negative sides of the Federal State Educational Standard of Higher Education (FSESHE), including for medical universities. We'd like to pay attention to the problem of implementation of educational standards in medical universities, particularly to the problem of the development of the content of physics course as one of the compulsory subjects. Thus, a distinctive feature of the introduced FSESHE is the lack of recommendations on the formation of the content of disciplines studied by students of medical universities. We analyzed work programs on discipline "Physics. Mathematics" (unit "Physics") developed by teachers of specialized departments of medical universities. The generalization of the obtained data showed that the content of physics course doesn't correlate with the peculiarities of the field of study of future doctors (a physics course for pharmaceutical faculty students has insignificant differences, but not in all the universities); the list of units and subjects of physics course as a rule corresponds to the content of medical physics course traditionally used in textbooks and study guides [1, 2, 3, 4, etc]. Interviewing teachers of specialized departments showed that:1) while developing work programs they traditionally turn to the content of well-known textbooks on medical physics; 2) they acknowledge the need to developing the content of physics course considering future professional activity of students; 3) they need methodical recommendations for revealing the list of subjects and units of physics course; 4) they note the significance of physics course for students of medical universities as bases for studying the modern methods of diagnostics and treatment.

Thus, we can state the fact that, against the background of the importance of physical knowledge for medical students, the problem of the formation of the content of physics course taking into account the specifics of future professional activity remains unsolved, principles (modes, methods) for the formation of educational content that are invariant to changes in the FSESHE weren't developed.

Methodology of the research

Based on the aforesaid, the purpose of our study can be formulated as follows: to identify the generalized principles for developing the content of educational material, guided by which it is possible to form a physics course for students of medical universities taking into account the specifics of their future professional activities. For achieving the purpose of the research in our opinion it is necessary to identify the following: 1) traditional mechanisms (approaches, principles, theses) that exist in academic literature; with the help of these mechanisms the earlier content of physics course was formed; 2) to compare well-known approaches with modern requirements of the FSESHE in order to identify a possible interrelation; 3) to form a new approach (principle, method, etc) for developing the content of physics course in a medical university and introduce it into the teaching process; 4) estimate the results of the introduction. The chosen logic of the research presupposed the application of different research methods at its different stages. Thus, to generalize pedagogical experience, to identify the relationship and new approaches to the formation of the content of physics course, methods such as comparison and collation analysis of scientific, pedagogical and methodological literature, synthesis of the obtained results was used. At the implementation and evaluation stage, the method of expert estimates was used in combination with the methods of mathematical statistics. We will gradually reveal the obtained results.

The obtained results and their analysis.

At the initial stage of our research as a result of the analysis of academic literature it was established that the controlling principle for forming the content of academic disciplines including the physics course At the initial stage of our research, as a result of the analysis of scientific and pedagogical literature, it was found that the guiding principles for the formation of the content of academic disciplines, including the course of physics, traditionally were the principle of fundamentality and the principle of professional orientation [5]. Implementation of the

fundamentality principle according to the researchers opinion [6, 7, 8 and others] allows to organize the teaching process of university students oriented to: 1) “comprehension of deep, essential foundations and connections between various processes of the world”; 2) “unity of the process and methods of cognition”; “mastering the complementary components of holistic scientific knowledge”; 3) the formation among students “a new level of rational thinking”; 4) “ensuring the assimilation of fundamental knowledge” (core, backbone representations related to primary entities; 5) “creation of unified cycles of fundamental educational disciplines related by purpose and interdisciplinary relations” [9, p.21]. However, nowadays, there is a shift from the fundamental model of higher professional education. Supporters of such a development strategy of higher professional education explain the given shift by “the quick growth of knowledge and its constant renewal, blurring of the lines between separate spheres of scientific knowledge” [10, p.9]. Still, to our mind only fundamental science can form among students a definite style of thinking which is characterized by the “fundamental power over all the knowledge, determined its stable ties, kept scientific knowledge in its strength, logical harmony and beauty” [10, p.10]. The modern fundamental science widens its borders; there is an interpenetration of various scientific fields. Thus, appearance of gene engineering, nanotechnologies and artificial testifies to the appearance of new directions in science and integration of science and technology. In this relation, the implementation of fundamentality principle acquires a new vision that does not contradict modernity, but ensures the availability of new knowledge at the intersection of sciences and production.

Speaking about the principle of professional orientation, opinions of famous scientists in the field of pedagogics A.Ya. Kudryavtsev, A.O. Izmaylov and M.I. Makhmutova can be identified. According to their opinion, the principle of professional orientation in the system of higher professional education performs a number of functions: 1) “providing system combination of theoretical and empiric knowledge in all the aspects of education”; 2) “combining the entire body of knowledge, skills and turning it into a tool suitable for constructing professional activities; 3) differentiation of education as a reflection of the specifics of professional activity on the content of academic disciplines; 4) “accounting and forecasting trends in the development of scientific and technological progress and its impact on trends in the development of professional activity” [11, p. 82-84]. In our opinion, one of the prospective variants of the implementation of the given principle is the one formulated by O.V. Mirzabekova [11]: implementation of the principle of professional orientation is possible through forming private professional tasks of a specialist in a certain direction of training among students. The author of the research is based on the provisions of the activity theory (V.V. Davydov, L.S. Vygotsky, N.F. Talyzina, P.Ya. Galperin and others) and their application (S.V. Anofrikova, G.P. Stefanova, N.I. Odintsova, L.A. Proyanenkova and others). Thus, according to psychologists and methodologists, a university graduate, including a future doctor, must be proficient in his professional activities and must solve private professional tasks.

Thus, principles of professional orientation and fundamentality are for our research one of the guiding ideas and requiring new approaches to their implementation in the formation of the content of physics course in a medical university.

The results of the next stage of the study consisted of the identified relationship between the requirements of the Federal State Educational Standard of Higher Education and traditional approaches to the formation of the content of physics course at a university (Fig. 1).

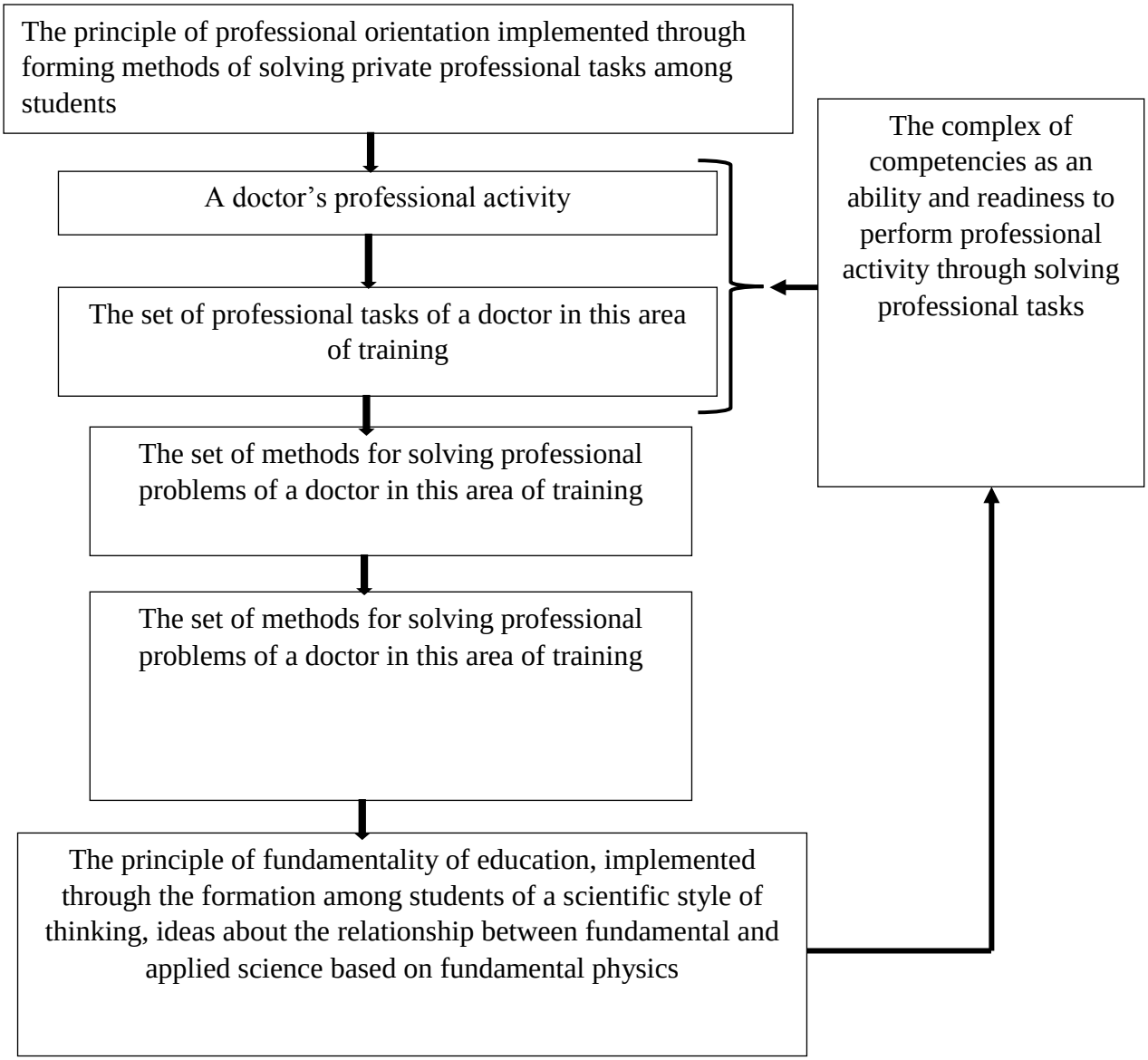

Fig. 1. Interconnection of didactic principles and FSESHE

Competency-based approach lies in the basis of FSESHE. According to it a model of a medical university graduate is presented, on the one hand, by a specialist possessing professional types of activity (medical, diagnostic, organizational preventive, academic), on the other hand, ready and able to implement the whole list of the given competencies. Analyzing the content of competencies, the formation of which it is possible and necessary to implement among the students of medical universities, we came to a conclusion that it is hardly possible to identify the content of physics course following only the list of competencies. In our opinion, there exists inverse relationship: the content of physics course and the types of activities connected to it, determine the choice of competencies.

Taking into account the principle of professional orientation through the formation of private professional tasks, it is possible to see, that the tasks solved in the framework of a doctor's professional activity, differ in their content. Thus, it is possible to find the solution of private professional tasks of a dentist, a pediatrician or a general physician applying different fields of biomedical knowledge. Obviously, the content of methods of solving private professional tasks allows distinguishing the content of physics course. There is no doubt that methods of solving professional tasks of different specialization doctors can be formed while studying biomedical disciplines, however a number of actions and operations that are included in these methods can be performed with the application of physical knowledge. Generalizing all the mentioned above, the following conclusion can be drawn: for forming the content of physics course for the students of medical universities, it is possible to: 1) identify competencies, that may be formed while studying physics; 2) identify the end purposes of competencies formation in the definition of competencies; 3) identify private professional tasks for a future doctor of the given training program; 4) identify the content of methods for solving the given tasks; 5) identify which actions of solving methods may be implemented with the application of physical knowledge; 6) correlate knowledge of physics with the unit, subject of the course of physics.

The result of the introduction of the given sequence of actions, the third task of the research, was the revealed content of physics course for the field of study "Pharmacy" (table 1). According to the content we developed a course of lectures, laboratory practice and a fund of evaluative means. Noteworthy is the exclusion of such units and subjects of physics course as "Kinematics and dynamics of translational and rotational motion of a solid body", "Mechanical vibrations and waves", "Electrodynamics and magnetism".

Table 1. The content of physics course for students – future pharmacists

Units of physics course	Subjects of physics course	Laboratory practice
Molecular-kinetic theory	The main provisions of MKT. Ideal gas, gas laws. Real gas. Van der Waals equation. Diffusion. Fick's law. Transport of substances through biological membranes. Liquids: Peculiarities of molecular structure of liquids, surface tension, surface tension force, surface tension coefficient, surface active agents, wetting phenomenon, capillary phenomena, viscosity. Newton's law of viscous friction, measurement methods of liquid viscosity	Laboratory work # 1. "Measurement of a pill mass with a torsion balance and electronic scales. Measurement error estimate" Laboratory work # 2. "Determination of air humidity and its accounting during storage of medicines" Laboratory work # 3. "The structure of biological membranes" (theoretical and laboratory work) Laboratory work # 4. "Determination of surface tension by the method of droplet separation and estimation of the errors of the obtained results" Laboratory work # 5. "Determination of liquid viscosity by the J. Stokes method and estimation of the errors of the obtained results" Laboratory work # 6. "Determination of fluid viscosity using a viscometer and estimation of the errors of the obtained results" Laboratory work # 7. "The study of capillary phenomena and the

		estimation of errors of the obtained results"
Optics	The laws of geometric optics. Wave optics: interference, diffraction, polarization, dispersion. Spectroscopy methods in the pharmaceutical industry	Laboratory work # 8. "The study of osmotic phenomena in the cell and the estimation of errors of the obtained results" Laboratory work # 9. "Determination of the wavelength and the estimation of errors of the obtained results" Laboratory work # 10. "Determination of the concentration of substances using a polarimeter and estimation of errors of the obtained results" Laboratory work # 11. "Determination of the refractive index of substances using an electronic refractometer and estimation errors of the obtained results"
Dosimetry	Dosimetry of ionizing radiation: ionizing radiation, radiative field characteristics. Clinical dosimetry. Dosimetry characteristics, absolute and relative measurements of absorbed dose, forming dose fields.	Laboratory work # 12. "Dosimetry. Measuring the level of radiation inside. Storage conditions for medicinal substances".

The last stage of our research consisted of introduction of the developed content of a course of physics for the students of pharmaceutical faculties to evaluate the system of actions we developed to form the physics course content for medical students from the point of view of the results obtained. It was important for us to get the assessment of the teaching staff and students – future dentists. For obtaining the objective evaluation of the teaching staff of physics departments of medical universities we considered it efficient to apply such research method as expert evaluation method. One of the variants of implementing the given method is obtainment, generalization and exclusion of random independent assessments from competent experts [12]. As a rule the given research method is organized in several stages. One of the initial stages is the purpose statement. In our research the purpose of implementing the method of expert evaluation was the following: to establish, whether the developed way of forming the content of physics course in medical universities is efficient, i.e. whether positively influences the process training future doctors. On the second stage we developed questionnaires where experts placed statements relating to the system of actions, results of its application, results of methodical system built on the basis of the developed content of physics course for medical university students according to the level of their significance. The obtained data ranged (the most significant statement obtained rank 1), then the combined rank matrix was composed. On the third stage we determined the level of agreement of experts. For this a hypothesis was formed: if the experts' opinions agree, then the developed system of actions is efficient and positively influences the system of training of future doctors. At that the qualitative measure of agreement of the opinions of a group of experts is the concordance coefficient (W), when the experts agree the concordance coefficient will tend to 1( ). The resulting value, the concordance coefficient (W=0, 91) with the Pearson criterion of 85.63 is less than the tabular (χ^2 calculated 85, 63 > tabular (56.2657) indicates a high degree of expert agreement in opinion on the efficiency of the system of actions we developed to form the content of physics course for students of medical universities taking into account the major; the obtained data is not random.

Conclusion.

The obtained data strengthened our opinion that the reformation of the system of higher professional education rests great responsibility upon the physics teacher in a medical university. This responsibility radically changes the attitude towards teaching profession. Nowadays regulatory documents and FSESHE set out only a general strategy for training future doctors. Therefore, the search for optimal and effective ways for training future doctors that suits modern methods of treatment and diagnostics is the task of the teaching staff. Like that, the content of physics course developed today can lose its relevance on the background of the rapidly developing technologies. Thus, the dynamism of the course and its time accordance can only be provided by the teaching staff. The application of the identified system of actions is rather a difficult process that requires physics teacher to interact with specialists of clinical departments and practicing doctors. Only under this condition, the content of physics course is not only the basis for studying professional disciplines, but is, in our opinion, stimulus and motive for future doctors to study physics. The results of the research proved once again that the harmonious combination of traditions of Russian system of higher medical education in the form of implementation of the principles of fundamentality and professional orientation as well as the competency model of a future specialist, will allow not to lose all the positive pedagogical experience and bring innovative changes according to the time requirements.

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