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PROJECT-BASED LEARNING AS A TECHNOLOGY OF MEDICAL PERSONNEL TRAINING FOR MODERN SOCIETY

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Topicality of the present work is determined by implementation of new Federal state educational standards of higher professional education aimed at forming students' competences as the main result of education. The objective of this article is to describe implementation and prospects of project-based learning at the medical university. Several educational projects are used in the microbiology course, which are directed to practicing procedures of the future professional activity as well as use of received knowledge for practical tasks fulfilling. Interdisciplinary project-based training in the specialty "Medical cybernetics" results in students developing automated workstations for medical personnel in hospitals. Advancement of students' competences takes place in conditions of team work and self-dependent decision-making. In the course of project realization students gain experience in solving modeled and real tasks in a health care institution, which is important for their further adaptation in the labour-market.

Keywords: project-based learning, competences.

ПРОЕКТНОЕ ОБУЧЕНИЕ КАК ТЕХНОЛОГИЯ ПОДГОТОВКИ МЕДИЦИНСКОГО ПЕРСОНАЛА ДЛЯ СОВРЕМЕННОГО ОБЩЕСТВА

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Актуальность данной работы определяется внедрением новых Федеральных государственных образовательных стандартов высшего

профессионального образования, которые направлены на формирование компетенций студентов, как одного из результатов педагогического процесса. В связи с этим *целью* статьи является описание внедрения и перспектив использования *методики* проектного обучения в медицинском вузе. В курсе микробиологии используется несколько учебных модельных проектов, направленных на отработку процессов будущей профессиональной деятельности и на самостоятельное применение полученных знаний для выполнения практических задач. Междисциплинарная проектная подготовка по специальности «Медицинская кибернетика» приводит к разработке студентами автоматизированных рабочих мест медицинского персонала в учреждениях практического здравоохранения. Развитие компетенций студентов происходит в условиях коллективной работы и самостоятельного принятия решений. В ходе выполнения проекта студенты получают важный для последующей адаптации на рынке труда опыт решения модельных или реальных задач в учреждениях здравоохранения.

Ключевые слова: проектное обучение, компетенции.

Introduction

New Federal state educational standards (FSES) of higher professional education for an enlarged group of specialties “Health Care” contain the competency-based approach to the pedagogical process. This approach results from the Bologna Declaration of European universities, signed by the Russian Federation in 2003. Implementation and realization of FSES make the issue of pedagogical technologies aimed at independent student work as well as development of skills to solve practical tasks in certain situations topical [1].

It’s necessary to involve students in vigorous activity, modeling some part of their future professional duties and allowing them to evaluate their aptitudes and possibilities for their realization. It stimulates students’ interest to independent problem-solving, acquisition of knowledge from various sources as well as

continuation of education in the selected qualifications. One of the innovation educational technologies targeted for this result is project-based learning. The project-based approach in itself has interdisciplinary nature and is considered by methodologists as a part of activity-based, personality oriented education.

The objective of the present work is to describe implementation and prospects of the project-based learning technology using in the medical university.

What is project-based learning?

An educational project can be defined as a complex of students' actions on solving a professionally important problem or its model, which leads to appearance of a certain product. It is in the course of problem-solving, when development of students' competences occurs. Project-based learning is a pedagogical technology, which to a great extent is oriented to satisfying needs of employers. Such learning contributes to formation of analytical, research, professional, communicative and social competences of students during supervision and consultations of teachers; besides, it develops the ability to cooperate in group problem-solving, make independent decisions as well as solve conflicts in a group of colleagues.

The technology of project-based learning has certain peculiarities [2]:

- a teacher acts as a guide and plays the role of a tutor, whereas creation of an educational project is oriented to independent students' work;
- the educational process is build on the basis of logical activity, which has personal meaning for a student and, thus, boosts his or her motivation;
- a student becomes a subject of the educational process; he or she independently sets tactical goals and determines a need for information, basing on the project idea;
- individual tempo of work on an educational project ensures its comfortable dynamics;
- profound digestion of basic knowledge ensures its use in different situations.

In medical education the project-based approach is used far more seldom than in pedagogical or technical one. On the one hand, practical training of medical specialists includes individual classes and transfer of knowledge and skills "directly from a teacher to a student". On the other hand, there are certain difficulties when formulating tasks and conditions for projects in subjects of traditional medical qualifications. Though teachers in a medical university rarely think in project categories, preparation and defense of a medical history by a student is an educational project.

We can point out the following stages of a medical educational project:

1. Elaboration of a project task aimed at resolving a professional problem through solving a series of stage tasks.

2. Compilation of a work schedule including ways and methods of project realization, timing and choice of criteria for the project quality appraisal.

3. In case of group work, assignment of duties and professional roles among project participants.

4. Project realization, from collecting and analyzing information to testing the final product.

5. Presentation and defense of the project in front of an audience of students, teachers, mentors and users of the project results.

We tried to use project-based learning in major educational programs of medical specialties in conditions of state educational standards of the previous generation. After the beginning of FSES implementation, this experience turned out to be very useful for forming professional competences of students.

Results of using of project-based learning

One of the aspects of the project technology in higher medical education is introduction of students to practically important problems for their future professional activity as well as ways for solving them. Project-based learning can be applied from the first years; at the beginning it should orient to model problems. One of the departments of our University which uses elements of project-based learning at initial

stages of education is the Department of Microbiology and Virology. A few educational projects are being used in the microbiology course, which are aimed at practicing certain procedures in future professional activity of students as well as independently applying the received knowledge to solve practical tasks.

While studying the general course in microbiology, students of all faculties realize the project on isolating the pure culture of microorganisms, which allows them to practice new notions from the section "Physiology of microorganisms", acquire skills of work with microorganisms as well as learn a new bacteriological method of diagnostics together with methods of determining microbial resistance to antibiotics.

At the first stage of the project a group of 2-3 students get a mixture of "unknown" microorganisms (analogue of the patient's material for bacteriological diagnostics). A task is to divide microorganisms and inoculate them into beef-extract agar in a Petri dish, so that singular isolated colonies of microorganisms from the mixture grow. At this stage students use knowledge on the composition of growth media and requirements for them; they also apply knowledge on pure cultures of microorganisms and the bacteriological method of diagnostics of infectious diseases; they compile the project plan (a scheme of isolating a pure culture and identifying it) as well as learn one of the inoculation methods for isolating a pure culture.

The second stage of the project consists in studying the colonies that have grown on the agar. Students prepare a smear from the selected colony, stain it using Gram's method and re-inoculate cultures from the colony in agar slant and infusion broth. This stage allows students to reinforce the received knowledge on microorganisms' properties in the culture, master methods of their inoculation in solid and liquid media as well as practice skills of preparing a bacterial smear, fixing it and stain it using Gram's method.

The third stage of the project is primary description of a pure culture by morphological, tinctorial and cultural properties and re-inoculation of the acquired culture in differentially diagnostic media for studying their enzyme activity. Students

use the knowledge on methods for study of enzyme properties of microorganisms as well as composition and use of differential diagnostic media; besides, they master inoculation techniques in these media and reinforce knowledge on the main properties of microorganisms.

The fourth stage of the project lies in studying the enzyme characteristics of a pure culture, determining from tables the supposed type and species of the microorganism as well as inoculating the isolated culture for resistance to antibiotics, using the disk-diffusion method. During this stage students learn to identify microorganisms by their enzyme properties, reinforce the acquired knowledge about antimicrobial drugs and master methods of determining microbial resistance to antibiotics.

At the fifth stage of the project students measure zones of bacterial activity of antibiotics, write a conclusion according to the project results and give recommendations on antibiotic treatment. Several students usually take part in realization of every project; it gives them an opportunity to acquire skills of group work. Students report on their results to the teacher and the group, answer questions and defend their conclusions.

To study the section “Special microbiology”, projects on diagnostics of intestinal infections (colibacillosis, abdominal typhoid, paratyphoid fevers, salmonellosis, shigellosis, cholera) and hospital-acquired infections (pneumonia, pyelonephritis, otitis, post-operation wound abscesses, sepsis) were elaborated at the Department of Microbiology and Virology for students of the Medical, Pediatric and Medical-Biological Faculties. A group of students play the role of workers of a bacteriological laboratory; they receive an appointment card from a doctor for analysis of a virtual patient’s material, where a provisional diagnosis is stated.

For inoculations of microorganisms nonpathogenic cultures are used, imitating causative agents of infectious diseases. During work over the project students study reference material and compile a diagnostic scheme. A part of results is received from analysis of ready inoculations in various media, but some part of results is

received by students themselves. They isolate a pure culture from suspicious colonies, re-inoculating them to agar slant; determine properties of microorganisms on stained smears; analyze inoculations in various differentially diagnostic media. When necessary, they take into account phagolyzis or phagotyping reactions along with diagnostic reactions for determining the titre of specific antibodies in serum of a virtual patient; determine antigenic properties of microorganisms in the slide agglutination test with suggested diagnostic serums and antibiotic resistance by the disk-diffusion method.

After finishing the project, students write a bacteriologist's assessment on the species (and if necessary – serotype) of the causative agent, suggest antibiotic treatment for a virtual patient. Students defend their projects in groups in teacher's presence.

Project-based learning has additional advantages in the interdisciplinary approach. Siberian State Medical University offers training in specialty "Medical cybernetics". For medical cyberneticists one of the fields of application of their competences is participation in development of medical information systems (MIS).

The domain for students' projects is information support of work of doctors, nurses and receptionists in health care institutions. The main goal of preparation of a course project by students is to get skills of analytical work necessary for creating automated workstations (AWS) for medical specialists [3]. Realization of projects takes place at the real medical institutions with participation of medical personnel. Clinical basis for students' projects over the last 6 years have been clinics of Cardiology Research Institute, Oncology Research Institute of Siberian Branch of RAMS as well as clinic of Siberian State Medical University.

In the tenth semester of studying every student (or a small group of students) majoring in "Medical cybernetics" receives the task to develop AWS for medical personnel. Project-based learning in this case relies on the curriculum and work programs of subjects that are included. In the course of project realization in-class

activities and independent work of students are coordinated within three subjects of the SSMU curriculum for specialty “Medical cybernetics”:

- fundamentals of systems analysis,
- medical data bases,
- information support of decision-making.

The project of an AWS, developed by students, is a common software complex and is designed for medical personnel and nurses. The project is oriented to a certain clinical or paraclinical field and consists of:

- base of medical-biological data,
- module for decision-making support,
- help system about peculiarities of the domain.

Each subject of the curriculum is connected with a certain software module of the AWS. Fundamentals of systems analysis teach skills of modeling information flows at a personnel workstation. These models play a significant role in data base development. In the course of learning the subject “Information support of decision-making” students design a corresponding AWS module as well as help systems. Summer practice after the fifth academic year is used to finish this educational project. Presentation of the project and its defense with demonstration of the AWS takes place at the beginning of the eleventh semester with compulsory participation of end users – medical personnel of health care institutions.

At the initial stage of project development students get information from personnel by interviews and questionnaires; they use formsheets of medical documents and expertise. Project realization begins from inspection of medical personnel workflows where students collect information and create the model of business processes. It is afterwards used in arranging information flows as well as elaborating the project of medical data base. The result of analysis and modeling is elaboration of formalized user requirements and technical specifications for AWS development. Besides, medical personnel set tasks to develop a program for decision-making support and help system.

At the beginning of implementation of this educational technology (2007-2008) each project had its own local data base. Over the last three years different AWS have been developed on one common data base. MIS architecture has become client-server. For example, in 2010 projects were carried out on the basis of Oncology Research Institute of Siberian Branch of RAMS. Nineteen students participated in development of ten automated workstations. Eight of AWS are working with common data base. This development appears as a model of real medical information system in a health care institution. In 2011 ten projects of automated workstations for consulting doctors and receptionists in the clinic of Cardiology Research Institute of Siberian Branch of RAMS were realized. In 2012 projects were carried out on the basis of the obstetrical clinic of Siberian State Medical University. Fourteen students took part in development of nine AWS on common data base; out of them four AWS were designed for doctors, four for nurses, and one for head of the clinic.

As in previous years, project realization began with inspection of medical personnel workflows and creating models of business processes. Students collected formsheets of all used documents, questioned and many times interviewed medical personnel, and analyzed certain examples. Every group of students developed a model of business processes at a doctor or nurse workstation using methods of structure modeling and IDEF standards. Logic of every model and correctness of IDEF notes were checked by experienced external analysts.

Approaches to assessment of student projects have been improved for six years. In 2012 assessment was carried out in three stages. At first teachers checked separate modules of every AWS: correctness of work with the data base, user interface, decision-making support, help system. Then joint work of AWS as a model of a medical information system was analyzed. Final assessment was given by medical personnel of the obstetrical clinic in the computer class of the laboratory for medical and biological information processing of the Medical Biological Faculty; the completed projects were installed there. Thus, the result of project realization was

assessed both by teachers of the Medical Cybernetics Chair in terms of professional competences of students and by end users in terms of functionality and usability.

Prospects of development of the project-based approach in higher medical education

Topicality of implementation and improvement of project-based learning increases with implementation of new Federal educational standards. In the curriculum of Siberian State Medical University for specialties "General medicine" and "Pediatrics" medical informatics is studied in the first and second years. Starting from 2013-2014 academic year, project based learning will be used in the second year. Creation of medical data bases, statistical data processing, test editor and presentations will be studied by students during project realization.

Protocols of clinical trials in depersonalized groups of patients and healthy volunteers will be used as model projects in the second year. Using Microsoft Excess and research protocols, students will form a base of trial results. Then descriptive characteristics of data together with the results of simple statistical processing will be received. In case of using more complex methods data will be exported and processed in Statistica package. The report about received results will be formed in Microsoft Word, the presentation - in Microsoft PowerPoint.

In our opinion, realization of a project through certain examples connected with the field of future activity will rise the effectiveness of mastering information technologies in the Microsoft office by students. Besides, to make training of graduates in medical informatics more profound it will be effective to introduce corresponding subjects as a variable element of the curriculum for specialties "General medicine" and "Pediatrics".

One more variant of project-based learning for students majoring in "Medical cybernetics" is attraction of students from other universities in the project team. It may be interaction with specialties connected with project management (the role of a leader), psychology, economics (introduction of corresponding roles in the project).

Interuniversity project teams bring the educational process even closer to reality of market developments.

The Microbiology and Virology Chair is also developing a model of interuniversity project. It is supposed that the project will involve the universities, where microbiology or biotechnology is taught: Siberian State Medical University, Tomsk Polytechnic University and Tomsk State University. Within this model students will be united in groups of 1-2 representatives from each university and receive a task to develop technical documents for a project of biotechnological process. Participants from Tomsk State University form technical specifications in terms of describing a supposed producer of biotechnological process. Students from Tomsk Polytechnic University develop parameters and features of a biotechnological process itself. Students from the Medical Biological Faculty of Siberian State Medical University describe requirements and the field of application of the supposed process product. This project is directed to profound studying of microbiology, biotechnology, application of theoretical knowledge and practical skills to develop certain biotechnological projects as well as compile proper technical documents. Besides, students learn to work in groups with various specialists, analyze one task from different aspects; moreover, they get first-hand understanding of their future specialty.

Conclusion

Project-based learning to a full extent realizes the competency-based approach, specified in the Federal state educational standards. Our experience has shown that students of the medical university are not an exception and can fully participate in realization of project works. During project realization students acquire experience of solving model or real tasks in health care institutions, which is important for their further adaptation in the labour-market.

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