UDC 378.147

Towards the Issue of Interdisciplinary Project Implementation in Engineering Education

Immanuel Kant Baltic Federal University

I.G. Kartushina, I.V. Garifullina, E.S. Minkova

The paper analyzes the function of interdisciplinary projects in the process of engineering staff training. It reveals the potential of a project method in the framework of the practice oriented approach while training students in a technical university.

Key words: Federal state educational standards, engineer, engineering education, educational process, active learning methods, problem-oriented methods, project organized training technology, design method, types of projects, the requirements for the implementation of designing method, professionally important qualities.

I.G. Kartushina

I.V. Garifullina

E.S. Minkova

There are great changes in modern practical engineering activities that set new requirements to the Bachelors, Masters and Specialists of Engineering. The modern society requires from engineers to combine the competencies of researchers, team leaders, managers, etc. Thus, it determines new competitive approach to the forms, methods and content of modern engineering education.

It explains the fact that the Federal State Education Standards of Higher Professional Education (FSES of HPE) of new generation include not only core social and functional competencies that are the basis for job performance but also such competencies as "to be ready to implement innovative projects into service industry" [1] and "to be a team member engaged in problem-solving, analyzing different solutions, consequence prediction, planning project implementation under uncertain conditions..." [2].

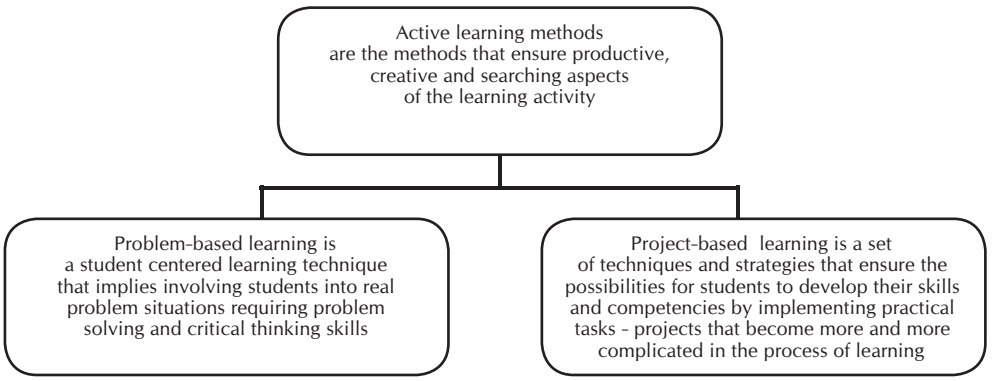
Thus, one of the main goals of modern higher school is to teach future specialists to determine and solve problems in their professional domain and to develop the personal skills that are important for project work. For this, it is necessary for the students to learn/acquire not only professional knowledge domain but also to develop the skills and techniques of problem solving in the framework of professional tasks. These aims can be achieved by organizing effective learning activity. It is the basic student's activity that plays the most important role in development of integral professional culture of a future specialist. It is the learning activity that significantly influences the personality of a future Bachelor, Master or Specialist, their ways of thinking, outlook, social behavior, character, capacity for work, problem solving skills, team work skills and personal development.

It is possible to state that student's learning activity is a way to form professional competencies and a motivating tool for cognitive and practical activities that, as a result, condition graduates' professional efficiency.

To increase the learning activity efficiency, a problem-oriented approach and project-based learning techniques are being widely used (Fig. 1).

These methods are considered to be active as they are student-centered. In this case a student has more opportunities to acquire practical knowledge and develop professional skills through creative and

Fig. 1. Types of Active Learning Methods.



searching activities, practical experience and problem solving skills development.

One of these methods is project-based learning. It's a pedagogical technique that is not aimed at integrating factual knowledge but is aimed at applying and deepening students' knowledge base, developing their skills and competencies.

The project-based technique always implies solution of some authentic problem that allows using diverse training techniques, on the one hand, applying integrated knowledge and skills from both engineering and social areas, on the other hand. It allows developing cognitive, creative skills, critical thinking, the abilities for knowledge structuring, data searching, working in team, which is significant for professional choice of the graduates. A lot of FSESs of HPE require such competence as "the ability for teamwork". It is project-based learning that provides the development of this competence through implementing group projects.

This learning method is often carried out in terms of students' independent learning activities – individual, paired or group- implemented during a certain period.

The types of projects used in educational process are shown in Table 1.

Mixed projects are most widely spread in the educational process of universities.

Regarding this process in Immanuel Kant Baltic Federal University (I. Kant BFU), programs "Service" and "Transport process technology", the following areas should be covered to develop students' competencies for successful project activities (Fig. 2).

One of the interdisciplinary projects implemented in the engineering programs in I. Kant BFU is a course project conducted by second-year students within the frame of the course "Machine Elements and Design Principles". The basic project stages are 1) Design - developing general construction of a product, and 2) Mechanical design – further detailed development of the idea that implies solving the problems related to real product implementation [3].

The course "Machine Elements and Design Principles" has the following prerequisites: Theoretical Mechanics, Strength of Materials, Applied Mechanics, Materials Science, Engineering Structural

Fig. 2. Areas of Project Activity Implementation in the University.

Materials Technology, Perspective and Shadow Projections and Engineering Graphics, Computer Graphics, Further Mathematics, Physics, etc.

A high level project in "Machine Elements" is a straight fusion of the courses mentioned above. These disciplines are integrated into one process and serve as a base for the final product.

Another example of an interdisciplinary project is the course project in "Passenger Traffic" that is supported by such prerequisites as Theory of Transport Processes and Systems, Simulation of Transport Processes, Social and Technical System Management, HR Management, Quality Management, Labour Safety in Highway Transport, etc.

This course project should contain specific proposals on improving passenger traffic management performed in the real system of city traffic routes.

While implementing different types of projects, students develop the following professional competencies:

- communicative skills
- open mindedness
- teamwork skills
- ability to prove his/her view point
- flexibility
- critical thinking
- ability to be engaged in independent lifelong learning and professional development.

The implementation of the project-based learning should meet the following requirements:

- scientifically or creatively significant issue/problem that involves application of integrated knowledge and research skills;
- practical, theoretical and cognitive importance of expected results;
- independent (individual, paired or group forms) students' activity;
- setting final goals of projects;
- determining the related competencies necessary for project implementation;
- project content structuring (with defining interim results);
- use of heuristic method of problem-solving, in case of group projects and statistical method if a project is individual.

For the foregoing reasons it is possible to conclude that project-based learning can be applied in any course module. This technique can be used in various forms as an in-class activity, independent students' work with different time limits and as a way of distant learning involving modern IT and computer technologies.

This approach to higher engineering professional education will allow considering professional and personal enhancement not only as a main indicator of professional activity but also as a core characteristic that indicates both specific professional competencies and opportunities for potential development of a future engineer.

Table 1. Project Types.

Classification parameter	Project type	Brief characteristics
Number of participants	Individual project	It is carried out by one student
	Group (team) project	It is carried out by a group of students
Project content	One disciplinary project	Its implementation involves the knowledge of one particular course or subject
	Interdisciplinary project	It integrates knowledge area of some related courses or disciplines
	Above-disciplinary project	It is conducted as student's independent scientific research work
Purpose of project implementation	Final	It is used to assess students' competencies acquired during a module or a basic education program
	Current	It is used to assess students' knowledge delivered in a part of a module or a course
Types of contacts	Group	Project involves students of one group or one year
	University	Project involves students of different specialties and programs within one university
	Regional	Projects involve students from different universities of one region through telecommunication and internet support
	International	Projects imply international relations, which means participation of students from different countries. They are conducted through telecommunication and internet support
Prevailing learning activity of students	Practice-based	Independently developed and produced product(service), recommendation package, publication for practical use – starting from the idea up to its implementation
	Exploratory	Studying some issue in accordance with rules of scientific research
	Informational	Collecting and interpreting related information and further presentation to the audience
	Creative	Maximum free author's approach to problem solving
	Role-playing	Business games with varieties of results
Duration period	Mini-projects	They are conducted during one class
	Short-term	They last during some classes
	Long-term	These projects 30-40 student hours or more involve
Complexity level	Level of beginners	Informational and creative projects
	Intermediate level	The main goal of the project is to find interdisciplinary relations by integrating the acquired knowledge and skills in the project activity
	Advanced level	Final qualification project

REFERENCES

1. FSES of HPE in specialty 100100 [43.03.01] «Service» (Bachelor's Degree) [Electronic resource]: approved by the Ministry of Education and Science dated 18.11. 2009 № 627 // Russian education: federal education portal. – Moscow, 2002–2012. – URL: http://www.edu.ru/db/mo/Data/d_09/prm627-1.pdf, free – Title from the screen (reference date: 16.05.2014). (only in Russian)
2. FSES of HPE in specialty190700 [23.03.01] "Transport processes technologies" (Bachelor's Degree) [Electronic resource]: approved by the Ministry of Education and Science dated 22.1 2. 2009 № 803 // Russian education: federal education portal. – Moscow, 2002–2012. – URL: http://www.edu.ru/db/mo/Data/d_09/prm803-1.pdf, free – Title from the screen (reference date: 16.05.2014). (only in Russian)
3. Shteinblit A.E. Course project in machine elements. Teaching guide. –Moscow, 1991. P. 432.