UDC 378

ENGINEERING EDUCATION 22'2017

Management the Writing of Bachelor's Graduate Qualification Work in Construction Based on Technology of End-To-End Course Project

L.A. Kulgina[1], L.V. Peretolchina[1], A.N. Rostovtsev[2]

[1]Bratsk State University, Bratsk, Russia

[2]Novokuznetsk Institute (Branch) of "the Kemerovo State University", Novokuznetsk, Russia

Received: 24.01.2017 / Accepted: 06.11.2017 / Published online: 31.12.2017

L.A. Kulgina

L.V. Peretolchina

A.N. Rostovtsev

Abstract

To resolve the issue of high-quality training of graduates in the field of Construction, in order to perform complex engineering activities, it is required to adopt new educational technologies and organizational forms of training. This article presents the implementation model of Bachelor's Graduate Qualification Work in Construction, as per IDEF0 methodology. The model is based on the technology of end-to-end course project work. The article demonstrates positive results of the model implementation in the learning process.

Key words: interdisciplinary integration, multidisciplinary integration, end-to-end course project technology, implementation model of Graduate Qualification Work, Bachelors of "Civil Engineering".

Introduction

The enthusiasm for future profession, motivation, systemic thinking, preparedness for solving inter- and multidisciplinary problems belong to the fundamental features of modern graduates of technical universities.

It is equally important for bachelors of "Civil Engineering". For example, the preparation for cross-sectoral activities in urban development, which cover creative research work and technical practice at all stages of production cycle of construction projects and urban areas, is the feature of the "Urban Construction" (UC) specialization. The production cycle involves design, construction, refurbishment and technical operation. Moreover, each of these stages considers the whole range of issues. In particular, the design involves simultaneous solution of urban planning, functional, structural, architectural and artistic, engineering and economic issues.

Therefore, it is required to prepare UC graduates who will be capable of resolving complex engineering activities, which cover the ability to *Plan, Design, Produce and Apply* engineering products and processes in the contemporary environment. It implies that students must be trained in accordance with the "4P" model, which is the basis for the Global initiative on reforming the basic (bachelor) technical higher education, CDIO Standard, to bring the content and the effectiveness of engineering education programmes in line with the development level of contemporary technologies and expectations of employers [1; 2, p. 48].

In our opinion, to resolve the issues of quality training of bachelors within provided time frame including the execution of Graduate Qualification Work, projecting the content of educational programmes is not enough. To improve efficiency, it is required to develop a detailed system of educational process management, specifically, "through the lens of super-discipline activities for mastering competencies" [3, p. 64]. We need a transition to new educational technologies and organizational forms of training.

Method

The development of General Cultural Competencies (GCCs), General Professional Competencies (GPCs) and Professional Competencies (PCs) required by the Federal State Educational Standards (FSES) is achieved by means of the competency-based approach, which is primarily characterized by interdisciplinarity. However, the effective achievement of the competency approach in education requires a clear understanding of "who regulates the process of mastering competencies and the gradual formation of competency, who and when records the achieved levels", "where and which competencies are formed in the learning process and what criteria prove that competencies have been mastered" [3, p.65].

For this purpose, our Department developed an integrated curriculum, which provides a distinct relationship between the content and the results of training in individual disciplines. Using the *technology of end-to-end course project*[1] this curriculum makes it possible to implement the multidisciplinary integration and "super-discipline" activities of students. The technology of the end-to-end course project includes a unit of disciplines integrated in accordance with the structure of material and information results of training. Through comprehensive and multidimensional consideration of the project object, the end-to-end course project makes it possible to develop course projects and term papers, which are closest to the practical engineering activity.

Also, thanks to interconnection of the project material, the end-to-end course project conduces to the productive, high-quality and timely work of students on their course projects and term papers. The end-to-end course project work is the basis, which assi8sts students in solving a more challe-nging task, i.e. the accomplishment of the Graduate Qualification Work in the short available time and at the adequate level.

Development of the process model

Along with support and management processes, the university educational process has a complex multi-level structure. This article considers one part of educational training of bachelors in a specific field. The article uses the example of its final training stage, which is preparation for the State Final Examination and its passing.

We developed ***the model of preparation for the State Final Examination and its passing*** (fig. 1, 2, 3), to demonstrate how to improve the development level of bachelor's competencies during preparation for the State Final Examination and also to reveal the relationships between all stages of the multidisciplinary process of implementation and defense of the Graduate Qualification Work.

This model was developed in accordance with IDEF0[2] methodology, which is also convenient for description of integration processes in education. The sequence, schematics symbols and arrangement rules of the process description in IDEF0 format were adopted in accordance with [4] as per governing documents[3].

[1] *The end-to-end course project work is understood as the parallel and/or sequential implementation of course projects / term papers in associated disciplines on the example of the same object. In earlier publications, we considered the technology of end-to-end course project work in detail.*

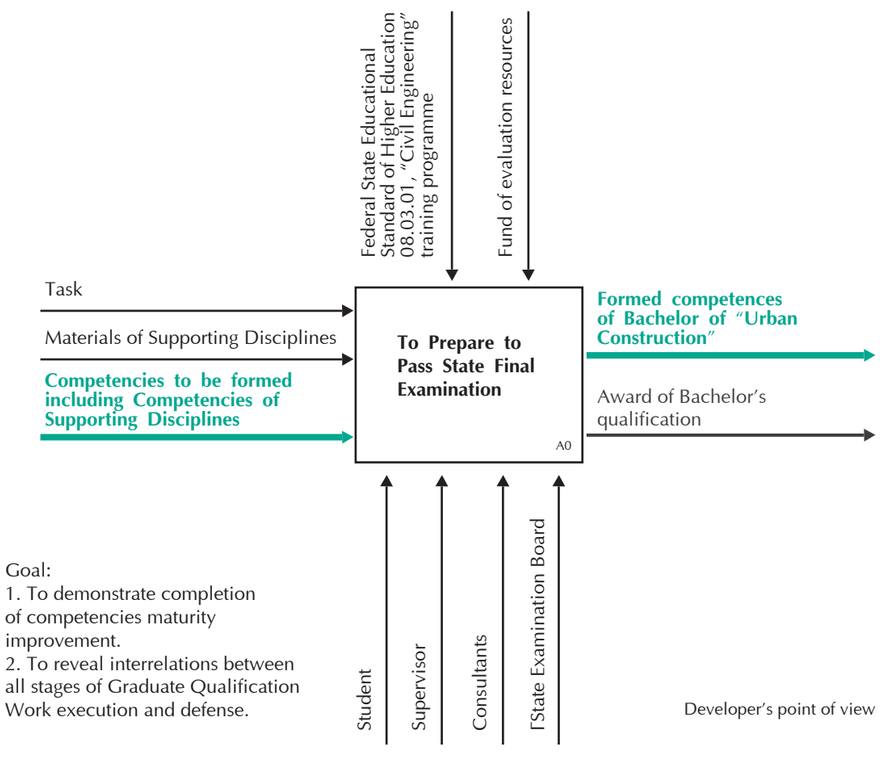
[2] *IDEF0-2000 (ICAM (Integrated Computer Aided Manufacturing Definition) is the methodology used to develop the functional model, which reflects the structure, the system functions and their binding information and material flows.*

[3] *Governing Documents - IDEF0 Methodology of Functional Modeling: Directive Document. - Moscow: Gosstandart of Russia, 2000. - 75 p.*
P 50.1.028-2001 Guidelines for Standardization. Information Technology to Support Product Life Cycle. Methodology of Functional Modeling. - Moscow: Gosstandart of Russia, 2001. - 54 p.

The behavior models presented in the rectangles are used to describe functions (work activities) performed by participants (by certain means). Participants include students, Graduate Qualifications Work supervisors, consultants and other individuals (arrows below). Left-hand-side- and right-hand-side arrows mean inputs and outputs of functions. Arrows on top mean management (managing actions, instructions, etc.). In order to obtain the description of actions sequence for successful implementation of tasks by students, each subsequent figure represents a stagewise breakdown (decomposition) of processes to the level of simpler sub-processes.

Fig. 2 demonstrates actions, material and information resources needed to commence Graduate Qualifications Work, and also the relationship between actions after

Fig. 1. Model of Preparation and Passing the State Final Examination (Contextual Diagram A0):
Competencies to be formed *– general cultural, general professional and professional competencies to be formed during educational process.*
Competencies of Supporting Disciplines (SDCs) *– competencies to be formed in the study of supporting disciplines.*
Materials of Supporting Disciplines (SDMs) *– graphic and text materials executed by students in the study of supporting disciplines and used at the State Final Examination.*
The formed competences of Bachelor of "Urban Construction" *– competencies mastered as per requirements of the Federal State Educational Standard, "Civil Engineering" training programme in compliance with "Urban Construction" specialization.*



Goal:
1. To demonstrate completion of competencies maturity improvement.
2. To reveal interrelations between all stages of Graduate Qualification Work execution and defense.

Fig. 2. Model of Preparation and Passing the State Final Examination (Decomposition of Contextual Diagram A0)

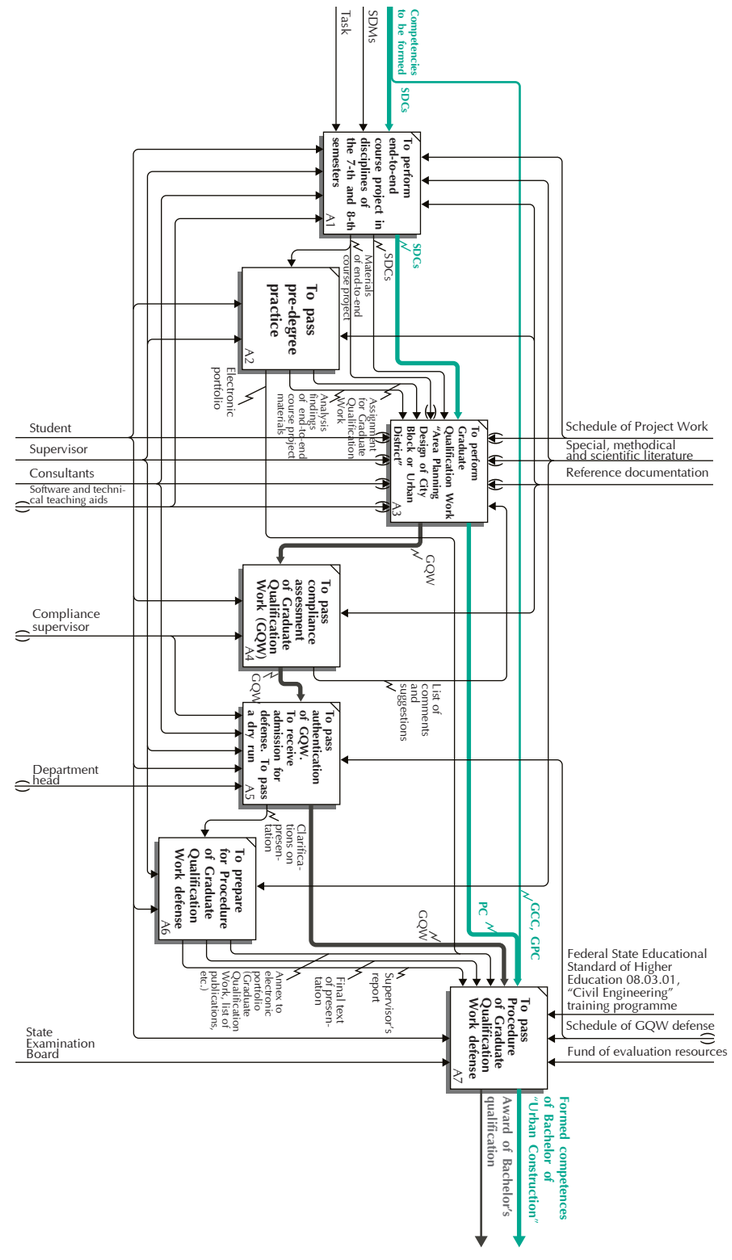
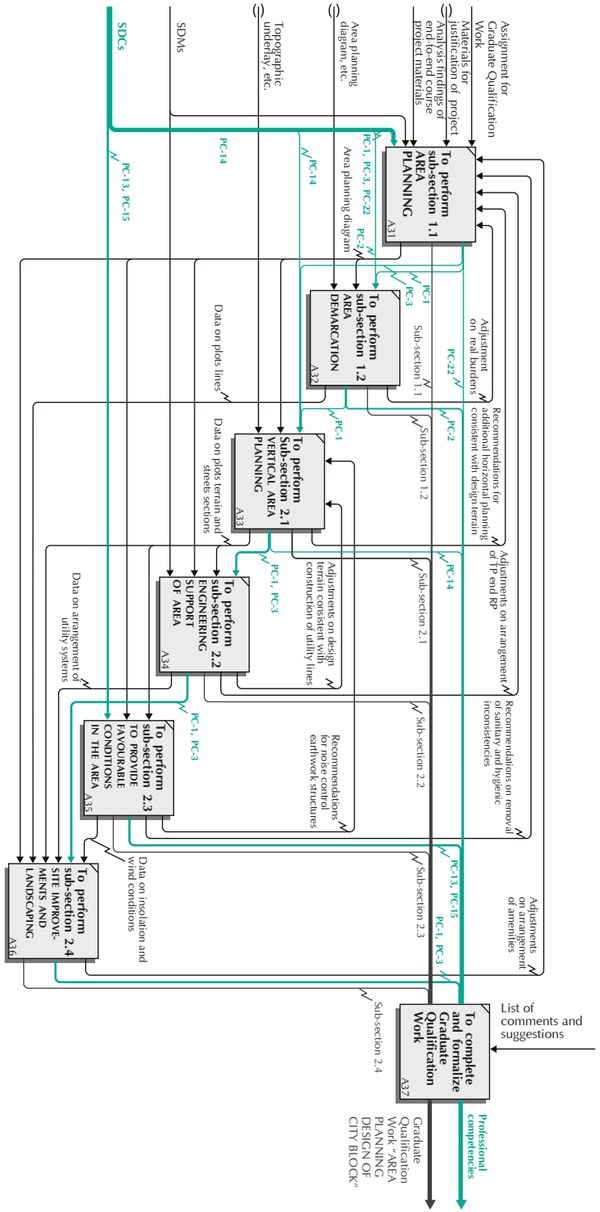


Fig. 3. Model of the State Final Examination Execution (Decomposition of Block A3)



Note – "Managing Actions" and "Participants and Means" in Unit A3, presented in Fig. 2 and related to each "Function" of the process, are not shown symbolically

implementation of Graduate Qualifications Work required for passing the State Final Examination. Furthermore, Unit A1, "To Perform End-to-End Course Project ..." and Unit A3, "To Execute Graduate Qualification Work ..." have a similar scope, but different goals. Thus, course project solves teaching objectives, and its goal is the formation of a broad range of competencies, that is to learn to use as many methods, techniques and modes of solving engineering problems, etc. as possible. The goal of Graduate Qualifications Work, as the final training stage is to confirm graduates' professionalism, impart completeness to the results of End-to-End Course Project Work and submit them in the form of urban planning documentation package. This would prove competencies maturity of bachelors of urban construction. Graduate Qualifications Work is expected to resolve the issue of transition to a higher professional level.

At the initial stage of end-to-end course project, students work in a team, afterwards they work individually. As the object, students choose a real development area in accordance with the General Plan of the city district. They offer alternatives for area segmentation and perform term projects that contain data on justification of the area planning design. Students have to solve multi-criteria problems of choosing the best alternatives and accommodate requirements of different disciplines including those, which are not assigned by the task, but have arisen or have been specified during end-to-end course project work.

Fig. 3 presents the implementation process of this multi-faceted and iterative task. Generally, the function "To Execute Graduate Qualification Work ..." includes the following:

Tasks:

- to improve the level of mastering professional competencies;
- qualitative and timely implementation of Graduate Qualification.

Input:

- competencies acquired in the study of supporting disciplines (levels of mastering competencies);
- assignment for Graduate Qualification Work;
- materials for justification of the project;
- analysis findings of end-to-end course project materials;
- graphic and text materials accomplished during the study of supporting disciplines;
- basic data for sub-sections of Graduate Qualification Work.

Management:

- project schedule;
- reference documentation;
- special, methodical and scientific literature;
- list of comments and suggestions from compliance supervisors.

Mechanisms (participants and means):

- students;
- Graduate Qualification Work supervisors;
- compliance supervisor.
- software and technical teaching aids.

Function definition:

The implementation of sub-sections that follow "Area Planning" gives rise to management feedback, which represents iteration. It means that the function output affects the future implementation of other functions. Subsequently, it affects the original function with a significant large dominance. If required, following the results of the next sub-section, previous sub-sections are adjusted. The completion of Graduate Qualification Work is followed by compliance assessment.

Output:

- developed professional competencies (competency development levels);
- final version of Graduate Qualification Work.

Results

The experimental verification of the developed model in educational process was performed for two years and covered Graduate Qualification Works from 2015 to 2016.

The State Examination Board evaluated clusters of competencies that combined those of the Federal State Educational

Standard in "Civil Engineering" Degree Programme, code 08.03.01. They included:

- ***Cognitive competence cluster.*** It reflected the availability and structuring of required professional knowledge, responsiveness to contextual and adequate updating (Professional Competence 1 and Professional Competence 13).
- ***Regulatory competence cluster.*** It demonstrateed the ability to use a range of available knowledge to solve professional tasks, the use of methods and technologies of professional activity (Professional Competence 2, Professional Competence 3, Professional Competence 15, Professional Competence 21 and Professional Competence 22).
- ***Professionally valuable competence cluster.*** It revealed capacity for self-organization, pursuit of self-education and motivation to perform professional activities (Non-Technical Competence 2 and Non-Technical Competence 7).
- ***IT-cluster.*** In this case, it reflected the degree of software knowledge and computer technologies in Civil Engineering and also knowledge of data work methods (General Professional Competence 4, General Professional Competence 6, Professional Competence 2 and Professional Competence 14).
- ***Communicative cluster.*** It demonstrated students' skills of public discussion and their ability to defend their project solutions (Non-Technical Competence 5 and Non-Technical Competence 7).
- ***Contextual cluster.*** It characterized the quality of project documentation and its compliance with the task, standards, specifications and other reference documents (Professional Competence 3, Professional Competence 15).

Fig. 4 presents the State Examination Board's assessments of competencies level of graduates during the State Final Examination in 2015 and 2016. The assessments were based on "low", "medium", "sufficient" and "high" grading levels. We may note positive results of the model implementation both among motivated students and those with a lower initial motivation. Among the 2015 graduate students, the latter group prevailed. These were objective data obtained with the Dean's office and based on our observations. Besides, the data agreed with those of our colleagues – authors [5]. In the course of Graduate Qualification Work based on the end-to-end course project, students significantly enhanced their motivation to studies and their sense of responsibility. In order to ensure consistency between all sections of the project, students were eager to find the most efficient solutions. In the course of work, students updated their knowledge, translated their previous experience in course project work and transformed the newly obtained data. In other words, the "inter- and multi-disciplinary approach to education taught students to obtain knowledge from different scientific fields without guidance, to group and accumulate it in the context of tasks to be solved" [2, p 52].

Summary

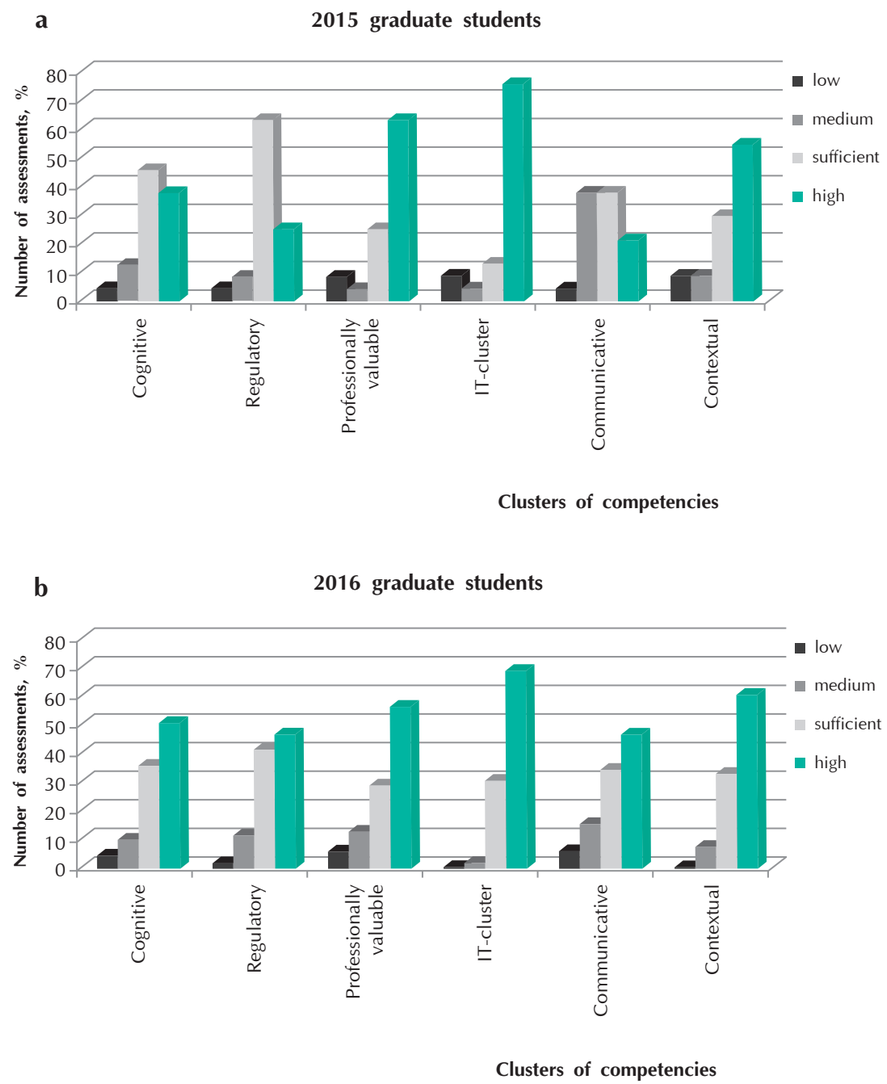
Thus, during passing the State Final Examination, we recommend to manage the process of Graduate Qualification Work through the end-to-end course project technology, which makes it possible to consider initial levels of competencies, trace their transformations in the course of performing the chain of sequentially and cyclically connected functions. This provides "feedback" in order to achieve the planned levels of mastering competencies, and estimate *the results achieved by students.*

This approach to bachelors' training allows to:

- significantly ***increase the level of competencies*** at any initial stage of students' motivation, due to multi-criteria objectives setting and solution of engineering tasks and a stepwise assessment of results;

QUALITY OF ENGINEERING EDUCATION

Fig. 4. Assessment of Professional Competencies Levels by Bachelors During the State Final Examination



ENGINEERING EDUCATION
22'2017

- through the use of interdisciplinary and multidisciplinary approaches, ***to develop the ability to "set a task" and interpret the results obtained***;
- ***develop skills in methods of system engineering***, other than simply include elements of real engineering activity in the teaching and learning process. It also means the creation of professional context as an integral model of future professional activity, including teamwork;
- significantly enhance ***the motivation and performance of students and teachers***, thanks to the focus on results and taking into account deadlines. It means the execution of Graduate Qualification Work at a high professional level within short deadlines and under existing conditions.

REFERENCES

1. Mezhdunarodnyi seminar po voprosam innovatsii i reformirovaniyu inzhenernogo obrazovaniya "Vsemirnaya initsiativa CDIO": materialy dlya uchastnikov seminara ["CDIO Global Initiative" International seminar on innovations and engineering education reform: materials of seminar attendees] in Zolotareva N.M, Umarova A.Yu. (ed.). Moscow: Publ. Dom MISiS, 2011, 60 p.
2. Sovremennoe inzhenernoe obrazovanie: ucheb. posobie [Contemporary engineering education] Borovkov A.I. [i dr.]. Saint-Petersburg: Publ. Politekhn. un-ta, 2012, 80 p.
3. Sosnin N.V., O probleme translyatsii kompetencii v soderzhanie obucheniya [On the problem of competencies translation into syllabus]. Vysshee obrazovanie v Rossii, 2014, no. 12, pp. 64–71.
4. Repin, V.V, Protsessnyi podhod k upravleniyu. Modelirovanie biznes-processov [Process approach to management. Modelling of business processes] Repin V.V, Eliferov V.G.. Moscow: Standarty i kachestvo, 2004, 408 p.
5. Kamchatkina, V.M., Sposoby povysheniya motivatsii studentov k obucheniyu [Ways to enhance students' motivation to studies] Kamchatkina V.M, Ivashchenko G.A. Aktual'nye problemy gumanitarnykh i estestvennykh nauk, 2013, no. 11-2, pp. 180–182.

UDC 378

Foreign Language Teaching Within "Aircraft Engineering" Programme

O.N. Martynova[1]
[1]Samara University, Samara, Russia

Received: 24.02.2017 / Accepted: 04.09.2017 / Published online: 31.12.2017

Abstract
The article discusses the issue of enhancing the quality of foreign language teaching at engineering university. Within the education programme "Aircraft Engineering", this issue is of particular importance due to the current situation in this economy sector. The article examines the problems of foreign language teaching, describes and postulates the language teaching system developed at Samara University.

Key words: ESP, integrated course, project-based teaching approach, content-based instruction, competency-based approach, teaching principles.

The issues related to quality enhancement of foreign language teaching at engineering universities have retained their relevance and received close attention of faculty members and scholars over the years. It happens because, despite enormous efforts being made, the learning outcomes of education programmes and graduates' knowledge do not completely satisfy the requirements of modern labor market, the level of international cooperation and up-to-date technologies and equipment. The issues of ensuring foreign language teaching quality at engineering universities, when there is a decline in the instructional time and increase in students' independent work, are of particular importance. In addition, alongside education programmes such as "Computer and Information Sciences", "Information Security", etc. where the significance of foreign language (especially English) knowledge does not leave doubts in anybody, there are a number of programmes that train students for so-called closed industries. It means that employees who work within these industries are not free to travel abroad. This fact actually reduces students' motivation to learn foreign languages as travelling abroad is one of the most obvious motifs for them to study a foreign language. This trend is particularly pronounced in the education programmes related to aviation and rocket and space equipment. Low students' motivation impedes enhancement of foreign language teaching quality and requires immediate attention form faculty members.

Let us examine the peculiarities of foreign language teaching within the education programme "Aircraft Engineering" 24.03.04. When formulating learning outcomes of the foreign language course, the Federal State Education Standards of Higher Education and employers' requirements were considered. This analysis revealed a serious contradiction. On the one hand, the share of aircrafts produced abroad is significantly higher than that of domestic ones. It means that it is required to read technical papers in the original and, if necessary, to communicate with foreign partners. Therefore, knowledge of foreign language is rather important for students enrolled in this education programme, and the requirements for the level of foreign language knowledge are very stringent. On the other hand, according to the Federal State Education Standard approved on 21 March, 2016, a student "should demonstrate the knowledge of one of foreign languages at the level that is not lower than conversational

O.N. Martynova