

Continuing pedagogical staff development in engineering University

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Abstract – In this article actualized the problem of the continuing pedagogical staff development in engineering University. The experience of realisation of complex multiple-level training system in Tomsk Polytechnic University is described.

Keywords – engineering education; teacher of higher school; training; continuing pedagogical staff development.

I. INTRODUCTION. ENGINEERING EDUCATION TODAY

In recent years Russian engineering education faced a number of global and domestic challenges. One of them is Russia joining the WTO which resulted in the urgent need to increase country's competitive advantage on the global market of engineering profession. Based on the survey done by the Association for Engineering Education of Russia the current state of engineering profession and engineering education in the country is not satisfactory (similar to a crisis or a stagnation) [1].

Before Russian economy transferred to the level of "new industrialization", which allows Russia to occupy decent position in the international system of labor distribution, there should be systematic integration of measures contributing to the increase of the quality of engineering education.

To achieve the desired objective teaching staff of technical universities should have a high level of competency both in research-and subject-based fields and teaching.

Increased demand to pedagogical component makes optimization of the system of professional and pedagogical education even more important.

The system of teaching staff professional development within the new objectives should quickly react to changing external requirements thus creating conditions for advanced continuous development of teaching cohort.

This study is aimed at synthesis, analysis and forecast of teaching staff professional development system within the engineering university.

II. SYSTEM OF TEACHING STAFF PROFESSIONAL DEVELOPMENT WITHIN THE ENGINEERING UNIVERSITY

Modern system of teaching staff professional development shall comply with the following basic principles:

- sufficiency – be focused on the implementation of relevant areas of higher professional education and meet the requirements of domestic and international standards;
- advanced training – implement university teaching staff professional development programs taking into account current and future perspectives of their activity;
- consistency – represent a complex system of interrelated and aligned components;
- continuity – create conditions for continuous development of teaching professionalism (including intercourse period);
- multi-tier system – ensure tier-based training of various categories of teachers – young specialists, beginners, actively working and having a huge teaching experience.

National Research Tomsk Polytechnic University has a great experience of professional and pedagogical development of university teaching staff. The system of professional development, which is being implemented at TPU today, meets the concept of CDIO international standards [2] regarding modernization of engineering education. TPU joined this initiative in 2011.

The university system of professional development has a multi-tier structure and creates conditions for continuous development of pedagogical professionalism.

The system includes the following training programs:

1. Additional educational program “Teacher of engineering higher school” (AEP TEHS)
2. Training program for beginning teachers “Pedagogical minimum”.
3. Short-term teaching staff professional development programs.
4. Complex module-based professional development program “Main areas of improvement in education”.
5. Program “International teacher of the engineering university” accredited by the International Society for Engineering Education and Modern Engineering Pedagogy IGIP.

III. TEACHER OF ENGINEERING HIGHER SCHOOL

The program “Teacher of engineering higher school” (1080 hours) is aimed at complex professional and pedagogical preparation of the young generation of teachers for productive pedagogical activity in the university. The program is being successfully implemented at TPU since 2001. In general program curriculum meets State Requirements [3] and is focused on the international level of engineering and pedagogical competencies accepted by IGIP Monitoring Committee [4]. The program implies the study of such disciplines as Didactics of Higher Technical School, Pedagogical Psychology of Technical School, Development and Use of Electronic Educational Resources, Pedagogics and Psychology of Interactive Learning, etc. Table 1 shows the compliance of program disciplines within “Teacher of engineering higher school” with IGIP international requirements [4].

TABLE I. COMPLIANCE OF AEP THEI TO ING-PAED IGIP CURRICULUM MODULES

	ING-PAED IGIP curriculum modules	AEP TEHS Educational courses
PM1	Theory and practice of engineering pedagogics	<ul style="list-style-type: none"> • Professional competencies of engineering university teachers • Pedagogical design • Theory and practice of pedagogical measurements • Design, management and quality assessment of educational programs • Teaching practice
PM2	Didactics of laboratory works	<ul style="list-style-type: none"> • Didactics of higher technical school • Pedagogics and psychology of interactive learning
PM3	Psychology and social studies	<ul style="list-style-type: none"> • Psychology of personality • Pedagogical psychology in higher school
PM4a	Rhetoric, communication	Rhetoric. Elocution

PM4b	Development of coherent texts	Scientific text style and language
PM5	Project work	Project management in education
PM6	Technical facilities, extramural studies, computer technologies	<ul style="list-style-type: none"> • Development and use of electronic educational resources • Technology of electronic teaching materials design • Education in the Internet: tools and technologies
WPM1	Ethics	<ul style="list-style-type: none"> • Professional and pedagogical ethics • Professional competencies of engineering university teachers

Planned program outcomes, its content and methods of implementation are continuously updated and adjusted in compliance with basic areas of education modernization. Capability building in project and research activity among teaching staff is extremely important in the context of competence-based approach principles. In order to develop this competency the following disciplines were included into program curriculum: Design, management and quality assessment of educational programs, Methodology and organization of research, Pedagogical design, and Quality assessment of PhD theses. Moreover, throughout the education students are engaged into project activity by implementing interdisciplinary course projects.

IV. PEDAGOGICAL MINIMUM

Another important component of teaching staff professional development system is the program “Pedagogical minimum” (16 hours). The program is aimed at staff members starting their teaching activity, which do not have any pedagogical training or experience, or the ones coming from industrial enterprises. Besides the main objective of the program – development of capabilities to start educational activity in the university, the program is concentrated on further development of pedagogical professionalism and individual-focused professional development of its students.

Students of this program are offered to fill in self-assessment questionnaires related to personal professional and pedagogical competency. The results of these questionnaires show that the majority of beginners have poor preparation to solve complex analytical and reflexive, constructive-predictive and corrective-regulatory tasks. Self-diagnostics allows to make conclusions on the need for further development of teaching competencies and define areas for professional improvement.

V. SHORT-TERM COURSES

Great emphasis is placed on retraining and professional development of teachers having pedagogical experience, who are facing the need to reconsider current approaches to design and implementation of the educational process.

The university typically offers its teaching staff a detailed set of short-term professional development programs (72 hours) in the following priority development areas of education:

1. Informatization of education.

2. Modern technologies of the educational process.
3. Key issues of FSES implementation.
4. Foreign language.

The above mentioned set of programs is presented at TPU by the following professional development programs:

- Project-based learning in engineering education,
- Planning and organization of students' independent educational activity,
- Competence-based education in engineering university,
- Design of basic educational programs on the basis of university educational standards,
- Modern tools and methods of competence-based education assessment,
- Development of quality assessment of test materials,
- Use of modern information-communication tools and technologies for proper organization of university educational process.

Short-term professional development programs seek to develop such professional competencies as:

- ability to develop documents for basic educational programs in compliance with FSES HPE requirements;
- ability to implement BEP modules of a new generation efficiently, to ensure achievement of competence-based learning outcomes;
- readiness to implement productive project-based education within the structure of integrated curriculum, ability to prepare university graduates to solve problem-based tasks of their professional activity;
- readiness to design, implement and assess the quality of students independent educational activity within individual-focused educational environment.

The program "Use of modern information-communication tools and technologies for proper organization of university educational process" represents a complex program combining educational and variative modules. The basic block includes a section devoted to university information policy. The variative block includes such sections as: Development of network educational resources: basic steps, Theory and practice of electronic teaching material design, E-Learning management system – MOODLE, Use of office technologies in education, TPU portal. Website and personal page management, FLASH design and use in education, Basics of 3D modeling in Autodesk 3DS MAX, etc.

In general the program is aimed at modernization of information-education environment in the university on the basis of modern information and communication tools and technologies, including computer and networking ones

(Internet). As a result of this program teachers develop their capabilities to design and use electronic educational resources for the organization of the educational process and students' independent educational activity.

VI. MODULE-BASED PROGRAM

Development of organizational forms of teaching staff professional development in the context of continuous education implementation lead to the creation of a flexible module-cumulative system ensuring efficient information and methodical support to teaching staff.

Module-based system includes a set of problem-oriented educational modules each of which lasts for 8-12 hours. The modules are developed in compliance with requirements to professional and teaching competencies of university teachers reflected in the document "Passport of TPU teaching staff". The passport contains 12 clusters of competencies, including ability to develop individual-focused educational environment putting priority on students' independent cognitive activity, organization of students' project and research work, setting objectives and plan learning outcomes, use of objective control and assessment methods of students learning outcomes achievement, etc.

Table 2 shows the extract from the list of competencies within the Passport of TPU teaching staff and modules developed within module-cumulative system aimed at development of corresponding competencies.

TABLE II. COMPLIANCE OF EDUCATIONAL MODULES TO REQUIREMENTS OF THE PASSPORT OF TPU TEACHING STAFF

Professional and pedagogical competencies of TPU teaching staff (extract)	Training modules
Ability to use modern educational technologies combining various forms of education and activation of students cognitive activity for efficient achievement of planned learning outcomes and educational program objectives	<ul style="list-style-type: none"> • Interactive learning technologies • Modern audiovisual technologies in university education • Use of interactive demonstration facilities in education • Simulation of interactive studies • Adult education principles and methods
Ability to use proper and objective methods and tools to assess students' learning outcomes and educational program objectives, including professional and universal competencies of graduates	<ul style="list-style-type: none"> • Development of assessment tools database • Design and development of students' independent work assessment tools • Development of test materials • Complex assessment methods of students' academic achievements within competence-based approach • Credit-ranking assessment • Quality assessment of pedagogical monitoring tools • Use of computer technologies in academic achievement assessment
Ability to use modern information and communication tools and technologies, including computer and networking ones (Internet) to ensure the educational process and students' independent activity	<ul style="list-style-type: none"> • Design of electronic teaching materials in HTML format • Electronic teaching materials as personal educational environment of a teacher • Technology of FLASH design and use in education

	<ul style="list-style-type: none"> • Development of MOODLE educational environment for electronic teaching materials • Basic information technologies on the basis of MICROSOFT OFFICE • Development of electronic teaching materials in the format of interactive PDF-document • Basics of ADOBE PHOTOSHOP
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Module-based technology of pedagogical professionalism development gives teachers the opportunity to create personal professional development plans. Teachers pick critical academic modules relevant to modernization of the educational process.

Students present individual projects focused on a specific methodical task. All projects are problem-oriented and are implemented to the educational process of the department. Teachers update documents within educational and methodical complex of disciplines, develop materials for assessment database, plan content and organization of students' independent activity, design teaching materials, acquire e-learning technologies and create electronic educational resources, etc.

Alongside with short-term and module-based professional development programs highly experienced teachers have the opportunity to be trained in the program "Teacher of engineering higher school - IGIP". The program was accredited by IGIP Russian Monitoring Committee and meets international requirements to professional and pedagogical competencies of engineering educators [4]. Program curriculum includes disciplines corresponding to basic modules of IGIP curriculum [4].

Teachers that passed the training within this program are awarded the title of International Engineering Educator ING-PAED IGIP. The growing number of university staff members having ING-PAED IGIP title contributes to successful distribution of advanced domestic and international experience of engineering education, enhances cooperation with leading

European universities and promotes the university joining the international educational community.

CONCLUSIONS

Summing up the experience of creation and implementation of TPU teaching staff professional development system it is noteworthy that from 2000 to 2013 the content of the system is being continuously developed. List of professional development programs covering beginners and educators with huge experience and aimed at competence development of engineering and pedagogical staff is being extended. Multiple components of the system ensure continuity of teaching staff pedagogical and professional development.

The system of university staff professional development is passing through some changes in the educational process. Combined and e-learning technologies are also being implemented.

The following potential actions will contribute to sustainability of professional development system:

- extensive use of individual-focused project-based education,
- implementation of interdisciplinary design principles,
- active implementation of modern distance learning technologies, including on-line learning.

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