

## Activity of The Engineering Teachers Association to Implement CDIO Concepts

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The article examines a new approach to higher engineering education based on the introduction of the CDIO concept. The possibilities to implement the world CDIO initiative standards which enable university faculty to design educational process in the modern way so that students' motivation to learn is constantly outlined. The experience of the Ural Engineering Teachers Association in implementing CDIO concepts to improve educational process is presented.

**Keywords:** engineering education, CDIO concept, project activity, association of teachers.

Today, Russia has made fast progress in developing international relations, strengthening business activity, globalization aspects that become challenging for the system of higher vocational education associated with appropriate changes to be made. In this regard, there are some dramatic changes in engineering education concerning transition to the team project-based learning.

A new approach to higher engineering education is intended to increase practical training, as well as problem and project-based learning. These aspects are presented in the worldwide CDIO initiative aimed at reforming engineering education [6 -9].

The basis of CDIO initiative was conceived at the Massachusetts Institute of Technology (MIT) in the late 1990s. In 2000, MIT in collaboration with three Swedish universities - Chalmers University of Technology, Linköping University and the Royal Institute of Technology - founded Worldwide CDIO Initiative [7]. Today CDIO Initiative consists of more than 100 universities around the world (30 countries). In Russia, the following universities became CDIO members:

- Moscow Aviation Institute (National Research University);

- Moscow Institute of Physics and Technology;
- Tomsk State University of Control Systems and Radioelectronics;
- National Research Tomsk Polytechnic University;
- Skolkovo Institute for Science and Technology
- Astrakhan State University;
- Siberian Federal University.

In September 2013 pilot implementation of CDIO approach was launched in the Siberian Federal University (SFU). SFU was given the status of CDIO initiative member on 16-17 January 2014 within the Regional CDIO Meeting in Chalmers University of Technology (Sweden).

The framework provides students with an education stressing engineering fundamentals in the context of Conceiving – Designing – Implementing – Operating (CDIO) real-world systems and products in the international market. This international project concentrates efforts to close the gap between theory and practice in engineering education. The new approach enhances hands-on training also by introducing problem and project-based learning [6; 8].

CDIO creates the necessary context for professional education, address program and curriculum philosophy, involves active

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methods of teaching and learning that engage students to solve practice-oriented tasks, focuses on faculty development including pedagogical competencies and skills in implementing operating systems and products, as well as program evaluation and students' learning assessment.

The CDIO Standards serve as a guideline to educational program design based on continuous activation of students' learning activity. Within the training process engineering fundamentals and social content of professional engineering activity are formed that allow to transform learning activity of students into real professional activity.

Creation of an Association of teachers of engineering universities of the Ural region is one of the steps that contributes to promoting practice-oriented training and project-based learning. This fact is rather actual taking into account that nowadays university teachers should be active and mobile, should monitor developments and achievements of colleagues and share their experience, participate in research, even in a distance mode [1; 2; 5]. Our experience has proven that it is more convenient and more efficient to act as a part of professional association, uniting enthusiastic and motivated teachers [4].

It should be noted that it is more reasonable and advantageous to form the Association of teachers, who work in the same specific field of training or have the same profile of educational program or department. For example, the Association of Teachers of specific engineering disciplines which brings together several universities in Russia: South Ural State University, Siberian Federal University, Perm National Research Polytechnic University, Ural State University, Chelyabinsk State Academy of Agricultural Engineering. The activities of this association are regulated by the following documents: Regulations on the Association, Code of Ethics for teachers – members of the Association and others.

To become a member of the Association a university teacher must apply for the

membership, that is realized at different hierarchical levels: intern, provisional member, member or an honorary member of the association. Obtaining a certain status is based on the analysis and evaluation of scientific and pedagogical achievements of the candidate in the research, methodological and innovation fields.

Initially candidates were approved under recommendation or introduction made by deans or heads of departments of participating universities. Thus the pool of members was created. Other teachers when applying had to introduce their scientific and methodological works, conduct a master class or submit a research report, that were evaluated and served as a basis to give a candidate a certain level of membership within the Association.

Teachers, members of the Association, interact in different ways, including active work in sessional period (usually 4 sessions a year), as well as continuous cooperation between sessions.

There are different types of activities foreseen for teachers during on-site sessions usually based in one of the participating universities, like workshops, training sessions, business games, presentations of teaching materials and scientific achievements and other. Between sessions the most popular forms of interacting are media lectures, online discussions, webinars, etc.

Such forms of activities organized for members of the Associations have some positive impact in terms of training teachers to apply team-work learning methods and project-based learning for students.

In particular, master class is one of the most effective forms of sharing teaching experience [3]. Therefore, within one session 3-4 master classes are held:

a) Analytical – «Analysis of the labor market needs for engineering graduates in the Urals», «Trends in engineering education development in Russia», «Regional specific features of engineering education» etc.

b) Teaching – «The concept of the course Fundamentals of Civil Engineering», «The concept of the course Production logistics», «Developing engineering and economic modules for the MBA program» etc.

c) Psychological – «Time-management for teachers and students», «Stalking the energy», «Effective solution of pedagogical task» and others.

Training activities not only focus on acquiring skills of problem and project-based learning, but also contribute to the development of personal skills and attributes of a teacher. These types of activities are especially accepted with pleasure by young teachers beginning their carrier, professors usually treat them skeptically and operate formally. Therefore, such classes are more successful among young (beginning) teachers. The highest ratings are given to the reflexive procedures «Tree», «Give a name to yourself» and «Advertising clip»; project drawing «I am the way I am», activities like «Carousel», «Teaching observations», «I've been lucky in my life» and «Hero of our time.»

A hosting university prepares a business game for each on-site session. For example, a business game «Who are our competitors,» showing the nature, mechanisms, pros and cons of competition; business game «Press Conference», focuses on professional self-development of participants, effective ways of planning professional activity of the university teacher, ability to implement reflection of difficulties and obstacles in the process of professional growth; game «Choice» assisting teachers who find themselves in a situation of professional crisis, making the right choice for the further growth and development in the profession.

Presentation of scientific papers and teaching materials is very important and quite effective form of implementation. There is no secret that many universities have their own printing houses and publish educational, methodological and scientific literature. These publications are often

«local» in nature and are not available for a wide pedagogical community. An opportunity to make presentation at the Association sessions allows teachers to be evaluated by colleagues from other universities and provides new market for disseminating their results.

During the inter sessional period, members participate in the Association activities through virtual departments, such as «Heat Power Engineering», «Metallurgy», «Software Engineering», «Computer Science and Engineering». It is important to note that each participating university is leading one of the areas, in other words, each university is responsible for one of the virtual departments. For example, the South Ural State University heads the virtual department «Heat Power Engineering». Each virtual department has its work plan, which is based on a survey of all members of this department on current issues in higher engineering education. According to the collected data the plan is developed and responsible members are appointed. As a result a special field of virtual department work was created called «Master lectures». These lectures are broadcasted live in the Internet. The topics of such media lectures are connected with those disciplines covered by department. As a rule, these are the topics that students have particular difficulties when learning and teachers share their experience of preparing and presenting such a complicated material.

Especially popular are the virtual master classes where teachers share their own features about workshops with students (in relevant disciplines) and how to better implement project and problem-based learning.

After the virtual lectures and master classes there is time for discussions which contribute to the development of ability of self-reflection, analysis of the possible ways for personal growth, increase confidence in their own abilities, help to express themselves in various aspects of teaching and development of positive thinking,

setting perspective and other professional objectives.

A new form of virtual work of the department deals with holding public lectures or practical (workshops, laboratory) classes. This form assumes an open broadcast in real time. From the Association members' point of view this form of professional experience should be extended.

It is noteworthy that online disputes as another type of activity for interaction of teachers was born quite spontaneously. At the website of the Association often new forum topics are started where teachers discuss various issues related to professional activities and exchange their views. Active discussions revealed the need for virtual online discussions through the media bridge. Among the most frequently discussed topics are the following: «Preparation and execution of grant applications in engineering fields», «Monitoring on», «Development of network educational and methodological complex of engineering disciplines» and others.

Effective form of the Association activity aimed at promoting the professional development of teachers in terms of introducing the CDIO approach is based on reviewing learning and teaching materials, research studies of colleagues from other universities. This is a mutually beneficial cooperation: the author promptly receives an external review, participants get critical

thinking skills to review the concept presented by the author also comparing with their own achievements and successes stories. Of course, many members of the Association are seeking approval of their achievements by the expert community within the virtual departments.

It is also important to focus efforts of the Association on bringing active learning methods in the framework of integration and closing the gap between various humanitarian and technical disciplines while making project work, modeling engineering processes, solving problems as in the real-world engineering practice. This integration is based on modeling real work situation within the training process, highlighting the key issues, searching possible solutions using knowledge and skills from different fields. Adoption of the principle that product and system life cycle (conceive, design, implement, operate) are the context for engineering ensure the most effective use of active learning methods in engineering universities.

Thus, teachers, members of the Association, are able to maintain the highest level of competence in their work; take into account modern society requirements and quality standards; continuously improve their professional skills; conduct research, using modern scientific tools and developments, what undoubtedly contribute to the quality of higher vocational education.

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