Chapter 36
A Synthesis of Training Systems to Promote the Development of Engineering Competences

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ABSTRACT

In the chapter, topical issues of development of the competence-based bilingual educational programs for training of specialists of an engineering profile, capable to solve at the international level complex scientific and technical challenges taking into account requirements of professional standards are considered. The special attention is paid to methodology of synthesis of training systems including virtual laboratories, computer simulators, and systems of imitating modeling for the practical-oriented training of specialists. The method of estimates of acquired professional competences on the basis of models of control of knowledge is offered, to implementation of scenarios and the analysis of protocols of training that allows to increase safety and efficiency of productions due to growth of qualification of personnel of industrial enterprises.

INTRODUCTION

Intensive development of modern production technologies requires preparation of a new generation of highly qualified specialists, ready to implement professional engineering activity at the international level, and capable of reacting timely to new and innovative technical ideas, and methods of implementing them. Amant and Flammia (2016), Azoev et al. (2012), Crawley et al. (2014), Filippovich and Filippovich (2015), Garrido and Morales (2014), Gomes and Bogosyan (2009), Heywood (2016), Kamens and McNeely (2009), Monsalve et al. (2016),Muratova et al. (2013), Rachford (2017), Rani and Ismail (2012), Sangaran et al. (2017), and Wu et al. (2015) discuss in their research the significant lack of a systematic approach to developing tutorials that satisfy as closely as possible the requirements of the modern labor market and the staffing of industrial enterprises.

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The specifics of forming the professional competence of specialists with an engineering profile, taking into account features of their professional activity in the international environment, assume acquisition of a certain amount of knowledge, ability, and skill that form the basis for a bilingual system in a certain field of activity (Veshneva, Singatulin, Bolshakov, Chistyakova, & Melnikov, 2015). Thus, the question of developing competence-based educational programs that meet as closely as possible the requirements of industrial enterprises, and are also accountable to the requirements of professional standards, is increasingly real.

The most promising direction for achieving competence-based results of training specialists with an engineering profile lies in creation of intelligent computer simulators that allow study of modern industrial equipment, training in management of engineering procedures based on virtual laboratories, and imitative mathematical models (Gomes, & Bogosyan, 2009). The solution achieves the objectives of implementation in the specified directions, through development of a single methodology, and technologies for automated synthesis of systems for the training of specialists.

The purpose of this work is the creation of methods and technologies to synthesize competence-oriented training systems, including models that represent informal knowledge, information, and imitative mathematical models; models of the trainee; a strategy for resource-and energy-saving control of engineering procedures; models of control of knowledge; and models of quantitative and qualitative standards for acquired professional competences (Grossmann, 2012). At the same time, development of competence-based educational modules on a bilingual basis (Russian and foreign languages) for training engineering specialists in professional activity is important insofar as it determines successful accomplishment of professional tasks in the conditions of a multilingual professional environment. Use of the such training systems enables increasing the level of safety in industrial production, increasing product quality, and improving ecological characteristics of the production environment, due to the increased professional level of specialists.

METHODOLOGY OF DEVELOPING BILINGUAL, COMPETENCE-BASED, FOCUSED TRAINING SYSTEMS

The lifecycle of creating competence-based training systems includes the following stages (Chistyakova, Novozhilova, & Zelezinsky, 2016):

- The analysis of qualification deficits (labor functions, abilities, knowledge) of specialists with an engineering profile, and their transformation into special professional competencies that allow specialists to carry out labor functions within new or significantly updated types of labor activity.
- Forming a trajectory and content of electronic training, based on modular technology of professional training and taking into account job descriptions and labor functions of managerial and factory personnel of industrial enterprises.
- Development of methods, algorithms, and technologies for synthesis of competence-based training systems (Gusev, Zatsepin, Nisman, & Kogan, 2014), including adaptable subsystems of imitative modeling for resource- and energy-saving management of engineering procedures.
- Approval of electronic training by synthesis of computer simulators via remote educational technologies (Titov, Smirnova, 2013).