Chapter 33
Virtual Practices, Virtual Laboratories, and Virtual Internship Experience in Engineering Training

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ABSTRACT

This chapter considers the current state, types, and relevance of modern virtual laboratories, virtual practices, and training in higher engineering education. The four types of virtual laboratories are considering. This work also offers examples of virtual scientific and engineering processes simulation laboratories and virtual remote laboratories, virtual practices, and internship. It analyzes the experience of universities and companies in the virtual laboratories, virtual practices, and internship. Particularly interesting for online learning platforms are the virtual laboratories of edX and the National Platform for Open Education. Finally, the chapter provides recommendations on the development of shared knowledge centers for collective use of virtual installations and laboratories, on ways of remote participation in collaborative work with real unique installations, and on participation in the distributed research unique installations and data processing tools. The authors also indicate directions of the development of supportive virtual internship programs for students.

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INTRODUCTION

The application of new technologies in education, for some reasons, still causes an alerted concern by the proponents of traditional educational technologies. Among the novel educational technologies are: online learning, adaptive learning with use of Big Data learning analytics, collaborative learning, mobile technologies, and game based learning. The main argument of opponents against mass use of new educational technologies, especially in engineering, is the statement that practical components are omitted from the novel processes of offered training. Also, the lack of practical training seems to hinder the preparation of specialists.

This apparent obstacle has been resolved by the creation of virtual laboratories. These virtual laboratories are able to simulate a complete equipment set and other devices' process. They also allow the visualization of processes that lay beyond the capabilities of the human eye or/and are hidden inside devices. Students are able to observe the direct connection between device control actions and the processes happening in physical objects, which are often or normally unreachable. The development of visualization graphics, image quality, and o video editing tools allows for a high-quality virtual reality with augmented reality effects.

Indeed, multimedia and augmented reality effects allow to model not only real, but also abstract objects and phenomena of any scale, which are often unavailable to direct observation. Examples are galaxies, nanostructures, and molecules. The field of virtual visualization has become a scientific analysis branch. It has been named scientific visualization, and is widely used in various theoretical and experimental studies. Up to date instruments of creation of computer games let to turn a game space into cognitive task objects (i.e., creative activities objects for students).

Virtual laboratories are exactly the elements that introduce practical components in the training process. The first virtual laboratories appeared nearly two decades ago and implied interaction of students with resources and with other students exclusively through the Internet and information and communication technologies (ICT). However, these instruments have not become common in the online learning process. The reason could be high costs of creation of virtual elements, which constituted a considerable share in online learning design and production.

The analysis of developments of virtual laboratories, practices, and internships in engineering education reveals three principle obstacles in their application. The first obstacle is the absence of a detailed methodological basis for manuals and self-guiding tools for a virtual learning application. The cases in which this problem has been solved obtained a robust educational resource. The second obstacle is the technical complexity of high-quality virtualization tools and their significant costs. This problem can be solved by outsourcing services for the development of commercial educational software. The third obstacle comprises the low level of knowledge of best practices of open information systems, faculty professionals who are insufficiently educated in the virtual laboratories application, poorly developed practices, and lack of internships in engineering education.

The solution of these three problems will definitely expand the application of virtual laboratories and thus will bring the practice component into the learning process.

The following new education technologies are providing the practice skill acquisition which is necessary in the practical works of engineering specialties:

1. - Virtual hands-on training and laboratories.
2. - Virtual internships and practices.