Simulation as an essential component in systems design training courses

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Abstract. The article deals with the problem of the availability of the implementation of design techniques in the educational process of higher education that implement a systematic approach to the problems of the subject area. The question is raised about the need to teach students the practical skills of project work, including collective, based on modern information technologies.

Keywords: information technology design, simulation, project management.

Introduction

When training specialists focused on the release of new scientific and technical products of high quality in the shortest possible time at minimal costs, it is necessary to introduce examples of the use of modern technologies using automated equipment, new ways of organizing the process of creating products, monitoring compliance with the highest level of product quality at all stages of the product life cycle (LC).

The higher education standard for training specialists in the design, production and operation of products of high scientific and technical complexity obliges educational institutions to provide students with the opportunity to acquire skills in modeling products and engineering facilities using standard packages and computer-aided design tools.

Currently, the tasks of product support throughout the LC are solved using spatially distributed systems (SDS) and the so-called virtual enterprises (VE).

SDS is based on free resources of real enterprises available for information interaction. In the modern sense, VE is a kind of production community created for a while to achieve a certain goal, for example, when it is necessary to integrate efforts within the framework of research and development, the development of various services (maintenance, logistics, communications). The most important characteristic of VE is the presence of complex high-speed information interactions in various modes; the ability to process large amounts of data in a single distributed information space. All this creates a need for teaching students the practice of collective online work on a project to introduce them to the world of advanced information technologies.

Purpose of the study

Show that the inclusion of important aspects of modeling and the use of modern software systems in design courses will not only lead to the formation of modern competencies in

students, but will also give a vector of development to the teachers of technical specialties. It is necessary, in order to teach students the basic concepts of modern computer technology, the principles of their work and innovations in the field of hardware and software tools and computer networks, to introduce practical exercises into the curriculum with the following tasks:

- Building conceptual models of systems of various types;
- Determination of the structure of subsystems, establishment of interconnections of elements;
- Verification of models;
- Formation of specification of requirements for the project;
- Registration of technical documentation and presentation of the project;
- Establish ways to carry out projects and use resources.

This list assumes the mandatory use of a significant amount of software and hardware in the educational process.

To acquire skills that provide the greatest competitive advantages in modern production, it is necessary to introduce into the educational process the implementation of practical tasks on the principle of collective development, coordination and operational control of project work [3].

Materials and methods

Based on the goals set, examples of tasks for improving the education process can be: studying the most effective ways of project execution and resource allocation; the assignment of roles and tasks for the implementation of basic design work, the development of specific technical specifications, the implementation of conceptual design, the preparation of technical specifications and instructions. If the final product of the design is an information system, then it is advisable to single out the stages of analyzing the organization's infrastructure, integrating subsystems into a single system and testing them; revision of the software; preparation for the implementation of the system; control and regulation of the main indicators of the project. If these requirements are met, the quality of students' final certification work will significantly increase, they will be able to compete more successfully in the labor market.

In terms of scientific and methodological support, the most promising can be considered a systematic approach, which allows, according to many modern publications, first of all, to link the procedures for analyzing both the design subject and the process of developing complex technical objects. By analogy with the use of a systematic approach in the design of information control systems, where the methodology combines modeling and reengineering operations, it is possible to identify in the designed product a set of product parameters that are optimal from the point of view of the entire life cycle of a technical system.

To solve this problem, it is necessary to consider the design object as a system, or a set of elements combined into a structure corresponding to the specified goals. The classical method, based on a systematic approach, involves the study of each of the objects that make up the system, as endowed with a set of properties that give them an unambiguous characteristic, elements. This complex also includes a description of the interaction between the individual elements that define the best mode of operation. The methodology has unique advantages for information support of technical systems, from the standpoint of a holistic model, including a description of each element of the system.

Localization of solving problems of the process of design, production and support of products no longer meets modern challenges, since it does not guarantee either high quality, or an appropriate level of organization of production processes, or a strict time frame for creating competitive products.

As is known, within the framework of the concept of CALS (Continuous Acquisition and Life cycle Support - information support of products, ISI), using an integrated information environment (IIS), the principles of design, construction, manufacture and maintenance of products are implemented. Modern project data management systems (PDM - Product Data Management) adapted for the educational process will teach students the basic functions of information support: a set of operations for working with design data, product configuration, project management, data protection. Such systems, which allow, within the framework of the educational process, to build a typical information model of a product based on objects, attributes, links from the standpoint of structural design, will significantly increase the quality of teaching. [4]

A systematic approach to the tasks of computer-aided design involves the implementation of joint design of a technological process (TP) and an automated control system for this process (ATPCS).

As an example, we can point to the **MasterSCADA™** software environment — the most modern domestic, innovative, powerful and convenient tool for fast and high-quality system development, which implements technologies in the field of creating large distributed software systems designed for real-time operation.[6] This product is implemented in the modern paradigm of an object-oriented approach, the development of all elements of the MasterSCADA project is carried out in a single tool environment, which significantly expands the user's ability to create new projects with high labor productivity. Documentation of project work is supported by the multifunctional Master Report editor. It is possible to build various options for the network architectures of the system within the project. The developer company implements a program of cooperation with Russian universities, it is possible to install a free demo version of

the product, which is especially important in conditions of distance training of students, and makes it possible to allocate a significant amount of hours for independent work, to simulate a remote access mode in the design organization of work, under the guidance of a teacher [1].

In addition to this system, we can also mention as an example the product **PDM STEP Suite** presented on the market – a computer system for managing data on a mechanical engineering product. According to the documentation [7], the purpose of the PDM Step Suite is to collect information about a product in an integrated database and ensure the sharing of this information in the design, production and operation processes. The PDM STEP Suite is based on the international standard ISO 10303 (STEP) (GOST R ISO 10303 is in force in the Russian Federation), which defines the schema (model) of data in the database, a set of information objects and their attributes required to describe the product.

In recent years, educational literature has appeared that takes into account these trends, however, the focus on specific industries does not allow to provide students with universal basic skills in the processes of modeling and support at various stages of LC products and designed systems without relying on the fundamental methods of the systems approach in the educational process.

One of the possible ways to overcome this contradiction can be the use of the **AnyLogic** software package in educational practice. This successful product, which has a modern visual interface, supports all conceptual models of systems analysis: simulation modeling, system dynamics models, multi-approach modeling, agent-based modeling [5]. The use of objects from built-in libraries, a developed training module, the presence in the reference module of examples of implemented models that imitate the behavior of systems in a real subject area, allow us to consider this product as a successful methodological means of implementing a systematic approach to research, design or management of complex processes. To the significant advantages of this product, in addition to the listed features, you can add the ability to use the cloud version in the work, the authors wrote about the benefits of these technologies in training earlier [2].

Results and discussion

Introduction to the educational process of practical exercises based on modern applied software requires some training on the part of the teacher. These methods give a significant positive effect when using project teams, where students have the opportunity to master various roles in the learning process within the competence of the future specialty.

Based on the material presented and the concept of education, as close as possible to the demands of the market for specialists in the development and design of software systems, it is possible to start mastering new techniques in the directions indicated in the article by using such

software products as: MasterSCADA™, PDM STEP Suite in the learning process, AnyLogic [5-7].

Conclusions

1. In the course of researching new trends in education and their tested use within the framework of the courses taught on design, the authors concluded that it is advisable to introduce elements of simulation modeling, build conceptual models of systems of various types, determine the structure of subsystems, establish relationships between system elements, verify models and others. modeling and design operations in the learning process.
2. The use of the AnyLogic software product allowed the trainees to master the skills of building a typical information model of a product based on objects, attributes, links from the standpoint of structural design, thereby significantly improving the quality of training.

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