THE SELENA TEACHING/RESEARCH SYSTEM FOR AUTOMATED DESIGN OF REMOTE DATA PROCESSING NETWORKS

V. M. Gostev and R. F. Khabibullin

The present stage of development of technical scientific and social progress has starkly highlighted the importance to the economy of the problem of improving the quality of training of technicians. The qualitative level of a technician is determined by the quantity, profundity, and diversity of knowledge, proficiency, skills, and experience in work. The quality of a modern technician is also determined by the level of development of reasoning power, creativity, independence and responsibility in making decisions, capacity for self-education, and ability to identify, pose, and solve questions and problems.

One of the promising trends that may provide an elevation in the quality of technical training is the development and widespread application of the resources of automation of the learning process using a computer, i.e., the computerization of teaching and learning.

The traditional tendency in the use of the computer in automating the educational process was to set up automated teaching systems. The use of automated teaching systems makes it possible to increase the efficiency of the learning process by individualizing the instruction, making it more descriptive, drilling the student more thoroughly in skills, monitoring continuously the mastery of the knowledge, and so forth [1-6].

However for the development of theoretical reasoning, a creative style of cognitive activity, and other qualities necessary to the modern technician, it is important to create the conditions for reflection on mental activities and operations and for independent foundational activity. This can be achieved by including in the learning process some problem situations and decision-making situations that require seeking out and selecting variant solutions, judging the consequences of different solutions, and a complex approach to the solution of the problem. A more active involvement of the student in the learning process can be achieved by strengthening the motivational side, which uses emotional factors, personal involvement, and heightened interest to intensify the learning process, and also conducting the teaching in conditions that simulate the actual practice of research, while the student is conducting independent research and developing designs independently.

Indeed, it is relatively easy to maintain the interest of a student in learning that occurs in a real-life context. It is significantly more difficult to achieve this end when the learning is of an abstract character. The mastery of knowledge in isolation (when the knowledge and its mastery are "strewn" over different academic disciplines), unsystematically and seemingly "to be stored up" does not promote the development of interest either in the knowledge itself or in future professional activity (for whose sake it is to be mastered in the first place).

In this connection special value attaches to the use of a new type of computerized teaching system—the teaching/research system, in which the mastery of knowledge, proficiency, and skills, the development of reasoning power and creativity, and the acquisition of experience are brought about in the course of independent intellectual activity by the student corresponding to a type of professional activity of the nature of research or design.

Moving the student into a professional type of activity leads to a transformation of the subject, themes, goals, resources, methods, and results of the activity. When a teaching/research system is used, knowledge and skills are acquired not as ends in themselves, but in the course of reasonable independent activity. This promotes the formation and emphasis of the theme of mastering the activity (i.e., the cognitive theme proper). The logic of carrying out the activity generates a need for new knowledge.

Design offers a broad foundation for implementing the teaching/research process.

The basis of the design process is directed search by the method of trial and error, which requires the use of accumulated knowledge and experience, prediction and planning of the activity. This is a process of

choosing and making decisions, which requires one to look at an extensive panoply of alternative solutions in each situation, isolate the essential factors and relations, set up experiments (trials), make a prediction, analyze and judge the probable results and consequences of the decisions that were made, and trace the cause-and-effect connections and the connections of the whole to the parts and the way they fit together. It requires imagination and flexibility of thought and a sense of what is important (depth of understanding) which makes it possible to narrow the region of search, examination of the problem from all sides, an estimate of the extent to which the decisions made are compatible with the conflicting requirements and criteria, and the resolution of these conflicts in the search for an optimal solution.

Design is a creative, fundamental activity having as a rule a complex interdisciplinary character. The basis of the design process is the formation of models of the objects and work with these models. Design is an iterative, cyclic process, at each new iteration of which the designer accumulates knowledge about the object and practical work experience. The design process involves the emotional sphere very heavily.

The use of computational hardware in the design process makes it possible to automate the execution of routine operations, cumbersome and laborious computations, and data processing, and also offers convenient and descriptive means of representing the objects being designed, their characteristics, and so forth. The complex solution of these problems is implemented in automated design systems.

Thus the design process can be made the foundation for the teaching/research process. The realization of this idea using the resources of computing hardware leads to the concept of teaching/research systems for automated design.

The choice of the object to be designed is of great importance in setting up teaching/research systems for automated design [7]. To train specialists in applied mathematics, computer hardware, systems analysis, and mathematical components of computers and automated systems (including automated design systems) networks for remote data processing are to a considerable extent a suitable object of design.

A remote data processing network is a multi-machine association whose main purpose is to provide computing and information service to geographically separated users.

In the general case a remote data processing network may consist of a large number of computers of different classes and users at smart terminals located at significant distances from one another, connected by communication lines (channels) [8–11].

Data exchange between the user terminals and the computers that carry out all the necessary informational-computational work, and also between different computers in the network is maintained by joint connections and various devices that control data transmission over the channels. Various kinds of hardware are used in this capacity—multiplexors for data transmission, or special computers for remote data processing. The connection of a computer, as well as a remote data processor or a data transmission multiplexor with the communications channels is effected using a data transmitting device, various kinds of which provide various transmitting capabilities of the communication channels.

A local (regional) remote data processing network assures remote access from the terminals to the resources of the mainframe of the network. In a common (global) remote data processing network the mainframes of the local networks are combined into a single whole through the basic data transmission network, which is the totality of data concentration nodes joined by communication lines.

The general problem of designing a remote data processing network consists of determining the structure and topology of the network (i.e., determining where to locate the mainframe computer, the local network concentrators, remote data processors in the communications network, and the means of connecting the components of the network with communication channels) and also determining the parameters of the components of the network, including the choice of the size of data blocks (packets) transmitted over the channels, the choice of the transmission capability of the channels, and the data transmission routes over the communications network. The quality of the design is judged by such characteristics as cost, reliability, productivity, and efficiency (time delays).

All design decisions are interdependent and require taking account of a large number of factors. Thus, for example, the choice of the topology of the communications network affects first of all the cost of the global network. However, that choice, together with other design decisions, also affects other characteristics—the reliability of the network and the size of the time delays in transmitting packets over the communication channels from sender to receivers. The choice of the transmitting capabilities of the communication chan-