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Increase of Engineering Students Training Level

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Abstract

The article considers the problem of the widespread introduction of computer technology in the training of students in technical areas. This leads to a significant deterioration in the quality of practical training. Implementation in the educational process of the laboratory complex, which represents a real model of the power plant, has led to improved academic achievement in core subject areas. This equipment allowed the students to gain practical skills for different types of works with the equipment on the basis of the University, and also helped to increase the interest of students in carrying out the laboratory and practical work.

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Keywords: Laboratory complex; performance enhancement; technical training; laboratory and practical work.

1. Introduction

In modern conditions of society development the rapid development of computer technologies and their application in all spheres of human activity takes place. It's not a secret for anybody that in recent years the information technologies are being introduced in the education system (Arbelaitz, et al., 2015). A particularly significant role they acquire in higher education. This applies not only to universities providing training in the Humanities, but also to technical universities. Increasingly, computer technology is used not only as a tool for creating text files and presentations, but also as a platform for creating and carrying out laboratory and practical tasks.

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1.1. Reasons

There are a number of objective reasons, among which are:

- Accessibility
- Compactness
- Speed of installation
- Safety
- Versatility
- A huge number of software
- Quick reinstalling and settings

The above reasons are even more advantageous in comparison with often outdated material and technical base. It is much easier to buy a computer with the software than, for example, to create student laboratories equipped with bulky and expensive equipment. Implementing the practical part of the training process for future specialists in some areas can be not only time consuming, but also very dangerous. For example, this applies to students of the field 14.05.02 "Nuclear power plants: Design, operation and engineering". For laboratory and practical classes on this profile, it is much safer to use computer models and simulators for nuclear power plants, for emergencies which will not lead to a real threat to the life and health of others.

1.2. Practical skills

In addition, the acquisition of practical skills of working with actual installations and equipment should be carried out during educational, industrial and pre-diploma practical training. In fact, and this is not always possible, since there is no opportunity to study the features of a structure, modes of operation, emergency on energized equipment. The entire practical training program is brought to trips and further examination of the technical documentation. In rare cases it is possible to study the constituent elements of the equipment, if the training period will coincide with the maintenance. Then students have the opportunity to see the equipment disassembled and participate in troubleshooting under the supervision.

This raises a serious problem of providing engineering students with a practical training which is based on computer models.

2. Methodology of research

2.1. Laboratory complex

In our opinion, to improve their technical skills students need a direct work with the current technological equipment (Abramenko & Mishunina, 2014). For this purpose the laboratory equipment, including a complete list of the main equipment of thermal power plant (Fig. 1), was designed and installed at the Department of Nuclear and Thermal Power Stations at the Institute of Power Engineering of Tomsk Polytechnic University.

The given diagram shows almost full compliance of the laboratory with existing thermal stations.

The laboratory provides a full set of heat exchangers and mechanical equipment of thermal power station: a steam boiler, a steam turbine, steam-water heat exchangers (heaters, a deaerator, a condenser, an expander, the first and second lift pumps, valves, steam- and water lines, and water-treatment system). Steam is supplied to the laboratory by the collector and then distributed to station equipment. The equipment is unique because it is miniature. The length of station heat exchangers is measured in meters, from 5 to 7 meters. Here, by the design, the plants made exchangers of small size to be able to place them in the existing premises (Fig. 2). All other processes are the same as at a real power station. Students have the opportunity to try themselves in all positions – from an auxiliary operator to a shift engineer.

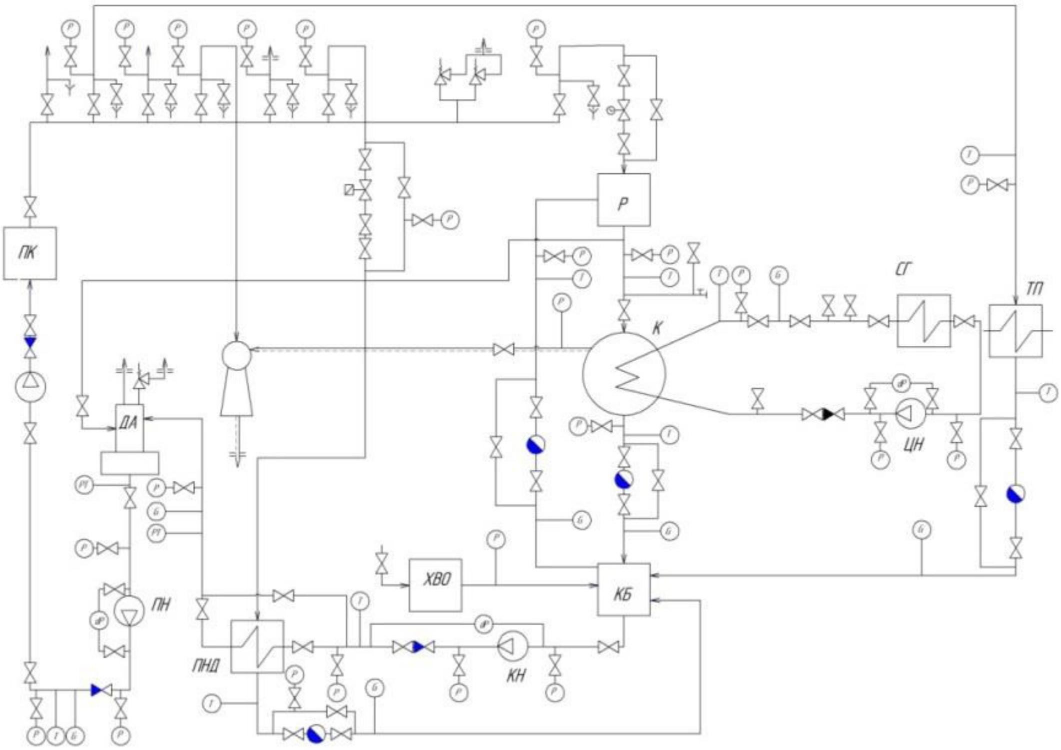

Fig. 1. Thermal diagram of the laboratory setup.

Fig. 2. The external view of the laboratory setup.

2.2. *Activities*

In the classroom students conducted the following activities (Lavrinenko, et al., 2015):

- Designing of heat transfer equipment, according to set parameters of the environment
- Installation and dismantling
- Disassembly and assembly of instruments
- Circuit design
- Performance of calculations for water-treatment equipment at nominal and emergency modes
- CHP start and shutdown
- Bringing the station to operating parameters
- Simulation of an emergency situation, decision-making on accident elimination
- Study of operation modes of turbine equipment
- Selection of an optimum mode of station operation

2.3. Interactive whiteboard

Certainly, it is unreasonable to completely abandon the modern computer technologies. An interactive whiteboard was used as an information component.

The complex control is done by means of interactive board. The interactive board not only allows immediate display of earlier prepared information, but also multiple changes of the board surface content. Special software provides tools for a fast display of ready images. It is possible to display information in various formats (formatted text in colour, tables, lists, figures, diagrams, animation, video and hypermedia) by means of a computer.

The interactive board is a surface sensitive to interaction (that is why it is called so) (Romashina, 2014). In other words, it is a large touch screen of a PC, allowing a public display of development of software or documents, or use of some application (Dikov, 2011).

Information can be dynamically scaled and displayed in layers. It is possible to use comments on a displayed picture or text during demonstration. All results of performed actions (history) can be saved as a file and handed out to students.

The board technology was used for displaying the laboratory setup diagram. The interactive feature of the board was used for control over a number of structural elements: valves, connections and pumps (Fig. 3).

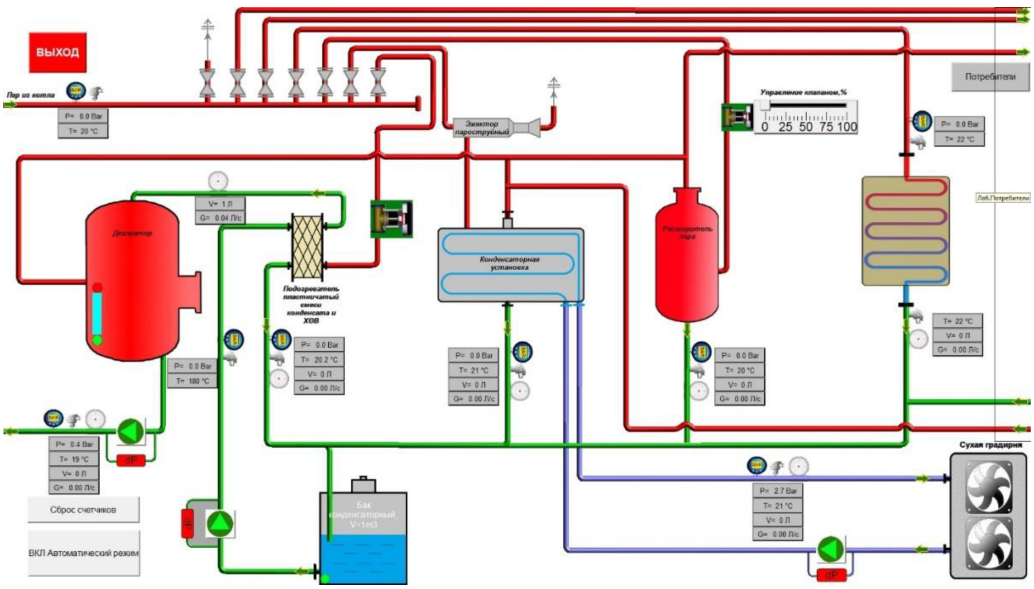

Fig. 3. Information displayed on the interactive whiteboard.

In future we plan to expand the board capabilities and increase the number of controlled elements. The possibility of some thermal parameters automatic setting is also considered, for example, now the pressure arriving at the installation is only determined by the boiler plant and is not adjusted. This will significantly expand opportunities for using the equipment for training.

This set of equipment brings a genuine interest among students. This applies not only to seniors, but freshmen as well (Lavrinenko & Kitaev, 2015). In particular, first year students were taken to an introductory tour of the laboratories of the Department of nuclear and thermal power plants. In addition to this laboratory, they also visited the laboratory equipped with computers, allowing modelling of various situations with the help of software products. Naturally, they showed a lot more interest in the actual hardware of their specialization.

3. Results

After a year of this laboratory complex using as a platform for laboratory and practical work, there was noted a significant increase in the level of student interest in studying the individual structural elements of power plants.

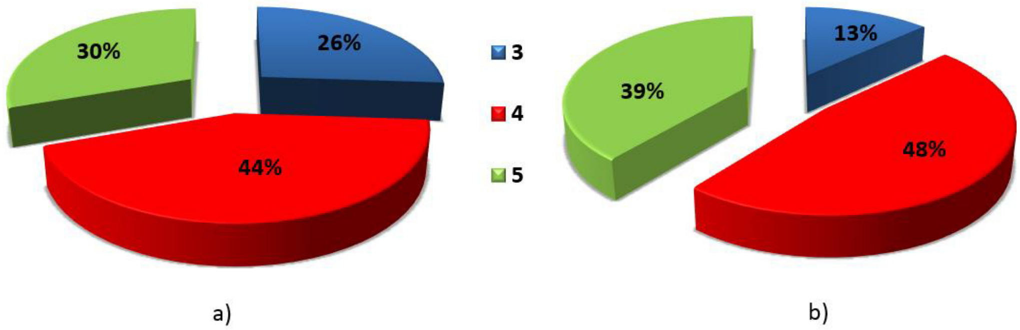

Fig. 4. Results of progress in the course "Thermal power plants"
(a) academic year of 2012-2013; (b) academic year of 2014-2015.

The results (Fig.4) suggest that when a modern practical laboratory is used in educational process, the academic performance of students in the specialized course "Thermal power plants" has improved. The number of students who passed the exam after the course with the satisfactory grade reduced twice, and the number of high achieving students increased by 9%. Comparative analysis showed positive dynamics and the increase in the average progress of students.

The main problem, when performing this kind of work, is the complexity of individual work organization, because there is only one effective installation. This problem is solved by dividing the group of students into subgroups based on their psycho-physiological characteristics. It will allow students to demonstrate their organizational skills (Sokolova, 2014). In addition, work performed on the same equipment for several semesters, is very convenient for both students and teachers (Pollak, et al., 2013).

4. Conclusion

Despite the wide range of modern computer capabilities that allow simulating various manufacturing processes, laboratory and practical training should be based on real equipment, as it was proved by the conducted analysis. Information products should be used only as a supporting means, or in cases of impossibility of using technical installations, for example, due to high degree of emergency occurrence. This applies in particular to higher educational institutions, providing training of future engineers, who will have to work not so much at the computer, but with actual equipment.

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