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# IMPROVING THE SYSTEM OF IT-SPECIALISTS TRAINING IN THE DIGITAL ECONOMY CONDITIONS

V. V. Andreeva (a)*
*Corresponding author

(a) Samara State University of Economics, Soviet Army Str., 141, 443090, Samara, Russia, AndreevaVV-IT@mail.ru

## *Abstract*

The digital economy is included in the list of the main directions of strategic development of Russia. IT specialists are the main driving force of this strategy. Existing training systems do not fully solve the problem of their training. Therefore, it is necessary to improve the pedagogical system of introducing students. The following criteria were selected as the main criteria for improving the IT training system: compliance of the graduate level with the required competencies; criterion for the maximum development of the student's abilities, regardless of his initial level. IT specials should perform two main types of professional activity – designing systems based on computer technology and maintenance and use of software and automated systems. It should be noted that when teaching students these types of activities, the process of servicing software or technical systems is not difficult for students, designing simple systems causes students big problems because it requires a large amount of additional research on the design object. The author's technologies for the development of research abilities are designed in such a way that in the learning process the student moves from the reproductive to the productive level: first, the activity is perceived as a research one, then, after accumulating knowledge and skills, it becomes an everyday tool, that is, perceived as a reproductive activity. Designed work programs for IT specialists training and complexes of developmental tasks with correction for changing IT have been used for many years in various universities in Samara.



**Keywords:** Digital economy, information technology, training system, levels of learning, development of research abilities.

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## 1. Introduction

The digital economy is included in the list of the main directions of strategic development of Russia until 2025. It is closely related to the development of information technology (IT) and causes the emergence of new opportunities that positively affect human life. IT specialists are the main driving force of this strategy (Fingramota, 2017). It should be noted that at present their level of training does not meet targets of digitalization. Therefore, there is a need to improve system of training IT specialists in universities in the country.

## 2. Problem Statement

Existing training systems do not fully solve the problem of training IT specialists (Andreeva, Abrosimov, & Grevtsev, 2019).Therefore, it is necessary to improve the pedagogical system of introducing students to the specialty using various forms of their training, education and development. The development of their research and creative abilities is the most important factor in specialists training of digital economy.

## 3. Research Questions

Modern pedagogical science studies the vocational education problems and training systems in the conditions of the information boom and the rapid change of equipment and technologies. The article discusses the pedagogical technologies development for research abilities formation of IT specialists. Their further improvement should contribute to an even more complete development and formation of the personality in a professional and panhuman plan (Andreeva, 2005, 2007, 2017; Andreeva, Abrosimov, & Grevtsev, 2019).

## 4. Purpose of the Study

The purpose of the study is to improve the quality of IT specialists training (Bowen, 2015; Blayone, Mykhailenko, van Oostveen, & Barber, 2018; Skinner, 2019). This purpose is achieved by improving the system of their training, using modern pedagogical technologies and allowing to carry out the training of specialists, scientific and teaching personnel in accordance with the social order of modern society and aimed at the prospect of its development. The following criteria were selected as the main criteria for improving the IT training system (Andreeva, 2005):

- compliance of the graduate level with the required competencies;
- criterion for the maximum development of the student's abilities, regardless of his initial level.

## 5. Research Methods

The general research methodology was made up of the basic principles of the theory of cognition, the formation and development of personality. As research methods, systemic, activity-oriented, personality-oriented approach were chosen (Lyashenko & Frolova, 2014). The study was carried out using methods of analysis of educational programs and standards, theoretical analysis and synthesis in the study of

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scientific sources, methods of purposefully constructing a system of new theoretical concepts, and theory of complex systems (Andreeva, 2007, 2017; Passey, 2014; Kozlova, 2018).

Applied simulation, situational and computer modeling of pedagogical processes and software design processes of computing systems. The methods of theory and practice of developing computer systems and the design of complex hardware and software systems was used.

## 6. Findings

The analysis of a large number of standards of various IT specialties, professional tasks, curricula, programs and pedagogical systems showed that the use of information technologies in various fields is associated with their specific features and requires the corresponding professional abilities.

In general, an IT specialt should perform two main types of professional activity (Andreeva, 2005):

- designing systems based on computer technology;
- maintenance and use of software and automated systems.

It should be noted that when teaching students these types of activities, the process of **maintaining** software or technical systems is not difficult for students, the **design** of simple systems causes students big problems.

This is due to the following circumstances:

1) in the general case, the initial data, algorithms and results of the system are not completely determined and require additional research and determination unambiguous specifications;

2) it is impossible to visually observe the processes in computer systems: they are “black box”. The correctness of reasoning in the design of the system can only be confirmed by the correctness of its reaction. In response to external influences, she must perform certain actions and form the required results.

Consequently, the design process of hardware and software systems is accompanied by the ambiguity of the initial information, the inaccuracy of estimates, the uncertainty of concepts and terms, the ambiguity of the natural language, i.e. uncertainty associated with the technical nature of the system and with the human factor (Andreeva, 2005; Korzhavina, 2013).

To remove this uncertainty, it is necessary to conduct a comprehensive study of the design object.

Thus, the most difficult task of training IT specialists is the formation of research competencies in the design of software and hardware systems, including

- skill to deeply investigate the task;
- clear definition of the goal and ways to achieve it;
- highlighting the most important details and discarding secondary ones.

In terms of system approach activity of the IT specialist at design of systems simplistically consists of the following stages:

- analysis and problem definition;
- development and research of different options of implementation;
- assessment and choice of the most rational option;
- implementation of the selected option.

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The two first a stage are the most difficult as for their implementation research abilities of the developer are required. In this case the research is considered as purposeful forming of new knowledge (subjective or objective) about an object in the conditions of information uncertainty and activity purpose uncertainty (Andreeva, 2005, 2007, 2017).

It can be concluded that the main most complex and demanded type of IT specialist activity is related to research activities. In the structure of any personality, according to the great Russian physiologist I. Pavlov, there are potential of research abilities. Therefore, the main goal of improving the system of training an IT specialist in the context of digitalization is to develop pedagogical methods for their development, and to bring them to a new, higher level (Henderson et al., 2019).

Since the ability to solve various, including research, problems is associated with assimilation level of a training material, these levels can be defined as reproductive (using previously learned actions to solve a **typical** task) and productive (using previously learned actions to solve an **atypical**).

The author's technologies for the development of research abilities are designed in such a way that in the learning process the student moves from the reproductive to the productive level: first, the activity is perceived as a research one, then, after accumulating knowledge and skills, it becomes an everyday tool, that is, perceived as a reproductive activity.

The possibility of using the task as a means of forming research behavior, as well as diagnosing its formation, is considered. Simplified process of solving the task can be represented as a combination of three components:

**"Initial situation – activity to achieve a result – result."**

Depending on how fully the characteristics of the components are determined, the solution of the task refers to the reproductive or productive level.

**Reproductive level:**

- initial situation and the result are fully defined, do not allow ambiguous interpretation, are "closed";
- activity is fully defined, "closed."

**Productive level:**

- initial situation is basically undefined, allows for ambiguous interpretation, requires the study and analysis of additional theoretical material and experimental data, clarification and formulation of additional conditions;

- result is open, mainly non-deterministic and consists of two components (the planned specific result and the objectively new result obtained in the process of activity).

- activity is completely non-deterministic, requires additional definition, generation of several options, their analysis and selection of the best option in accordance with certain criteria.

The result of the activity is an objectively new knowledge for the student. Students who have reached this level have research abilities. A set of tasks has been developed related to the design of models of various computer devices: in the process of solving them, the student moves from the reproductive to the productive level and develops research abilities.

Examples of tasks of the reproductive level are the tasks of performing arithmetic operations of addition, subtraction, multiplication and division of two given numbers: when they are performed at given

values of the source data, the only correct result is always obtained. In IT disciplines, these types of tasks are usually not found, but can be part of a more complex task. A typical example of tasks that develop research abilities is the modeling of processing keystrokes on the keyboard keys. The initial situation is not defined, it depends on which groups of keys are modeled, requires additional study of theoretical material to refine the initial data.

The result is open, until the student forms additional modeling conditions, it is unknown. As a rule, the result contains two components: the planned result and the objectively new for the student obtained in the process of designing the model. Student activity is also not defined: the design process largely depends on the generated input data and the expected result – different students can develop different models that reflect different keyboard aspects.

The development of the model requires that the student study in depth the operation of the keyboard processor, keyboard driver, the functions of the operating system, the structures of the RAM, corresponding to pressing different groups of keyboard keys, etc.

Thus, in the process of solving the task, research abilities inherent in the student's personality are developed. Designed work programs for IT specialists training and complexes of developmental tasks with correction for changing IT have been used for many years in various universities in Samara.

## 7. Conclusion

An analysis of the features, methods and techniques of organizing IT specialists training has shown that the most difficult task is the formation of research competencies in the design of hardware and software systems. For the purpose of their development, author's pedagogical technologies have been developed that allow students to develop the research abilities laid down by nature.

The developed methods for the development of research abilities were tested on various groups of students – engineering schoolchildren, college and university students, teachers of many Samara and Togliatti colleges and universities, teachers of schools in the city of Samara and showed good results.

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