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Development of human potential of the national economy through the use of digital technologies in education

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***Abstract* —The article discusses the theoretical foundations of creation and the content and methodological issues of the development of an information educational environment for training an IT specialist using distance learning technologies. The use of current technologies in education can be implemented through the development of educational information sphere.**

For the development of computer training systems that ensure its personification, it is necessary at least to be able to measure the process of mastering the material and the complexity of tasks. The experiments on real data allow us to conclude that it is possible to develop such systems.

Keywords — higher education; digital technologies; online learning market, management; innovation

I. PROBLEM STATEMENT

Extensive promotion of information technologies (IT) in various fields of activity, the formation and provision of the latest information services, the implementation of the concept of global information infrastructure, the dynamic development of the IT industry and IT business has turned the field of information technology in the field of practice of professionals. Long-term forecasts of specialists in the field of employment and public research show a growing trend in the need for industry and business professionals in information technology.

The relevance of the study is determined by the complex and dynamic nature of the professional activity of the current IT specialist, the use of new information technologies in it, resulting in the improvement of the system of high-quality training in the field of information technology at the University.

A characteristic feature of the training of IT specialists in comparison with the training of professionals in other areas is the subject of their professional activities associated with the use of computer systems, as well as hardware and software of electronic computer equipment. Considering the experience of foreign and domestic researchers, it is possible to identify more important trends common to the formation of a professional school in different countries:

- expansion of the profile of training of specialists; humanization of technical and natural science education and, on the contrary, promotion of technology in humanitarian education;
- on the basis of education diversification combination of elitist and democraticc principles;
- transition from classical disciplinary and professional prescription training to multidisciplinary, problem-oriented education, its transformation into a system of continuous education, which includes all kinds of flexible educational structures.

II. MAIN CONTENT

The subject of modeling of the educational sphere on the basis of distance learning technology is disclosed only in the procedural aspect, not fully provided for the characteristics of the system, synergetic, personal-active and other approaches. The weak point, in our opinion, in the analysis of the impact of distance learning technologies on the effectiveness of the educational process, in particular, can be identified a formal approach of evaluation, prevailing in practice and expressed in the mechanical accounting of the number of didactic materials and technical resources of the new generation, which are used in training. High-quality analysis of the processes occurring within the system under the influence of the latest technologies does not allow carrying out such an approach.

Nevertheless, in the educational information sphere of training of IT specialists with the use of methods and technologies of distance learning, the learning process includes not only the processes of interaction between the teacher and the student, but also the whole complex of conditions and relationships that affect the student. Studying this problem, we see that the introduction of distance learning technologies in the pedagogical traditional system requires a radical change in the whole complex of the process, conditions, relations, content of education, which makes it possible to consider distance learning technologies as a system-forming function of the information educational sphere of training IT specialists in higher education.

To assess the impact of the system-forming function on the information educational environment of the IT-specialist training, it is necessary to implement the modeling of the information educational environment of the IT-specialist training at the University using distance learning technologies.

However, it can be summarized that the issue of development of educational information sphere of training of IT-specialists on the basis of distance learning technologies to

increase the effectiveness of the outcome of the process of vocational training remains very relevant. The analysis of the works of the above authors makes it possible to conclude that the majority of researchers consider only general theoretical aspects of the information educational environment. Such aspects as the theoretical basis for the creation and content-methodological issues of the information educational environment of IT-specialist training with the use of distance learning technologies are not considered.

Thus, nowadays there is a need to resolve objectively formed contradictions:

- between the existing level of IT-specialists training at the University and the increasing requirements of employers for their training;
- between the impossibility of using IT-professionals because of the lack of development of theoretical and methodological aspects of its creation and use and the potential of the educational information environment of their training;
- between the limited opportunities to meet this need through the use of traditional didactic tools and educational models and the need for enhanced implementation of distance learning technology in the University.

In addition, universities are one of the main repositories of traditions and scientific heritage, which comes into some controversy with the fact that the training of IT-professionals should apply new scientific achievements in the field of information technology, educational practice has the need to specify the content of the concept of educational information environment and determine the possibility of combining traditional pedagogical and distance learning technologies to increase the effectiveness of training IT-specialists. The need to resolve these contradictions determines the importance of the problem.

Educational activity in Russian universities has recently been characterized by the accelerated formation and extensive introduction of electronic teaching technologies, including the use of the Internet, educational and methodological multimedia materials, remote laboratory workshops and other electronic resources of the educational direction. Universities, at the level of state regulatory documents, have acquired the ability to establish their own activities for the organization of the educational process using distance learning technologies. The use of information and communication technologies in the field of education provides an opportunity to build an educational sphere that provides any individual with a personal learning path, almost independent of external conditions.

According to experts, the online learning market in Russia shows an annual growth rate of 25%. At the same time, the volume of the Russian market in 2018 is only 10.5 billion rubles, while the volume of the world market is estimated at 107 billion dollars. Also, according to experts, 7.2 million Russians have resorted to online training services at least once. The main problems of the market include a relatively low level of profitability.

The relationship of the territory and the number of population with higher professional education and using e-learning in the regions of the Russian Federation for 2018 is presented in Figure 1.

To address the objectives of our study should specify the nature, content and characteristic features of the notion of technologies of distance teaching. It should be noted that the distance form is a method of training. Therefore, it is more accurate to talk about distance learning, not distance education. In accordance with the current regulations, this technique can be used within the existing forms of education, which are provided by law (full-time, part-time, external studies). Meanwhile, in the context of the development of the "knowledge economy", the traditional education system, according to most analysts, is not able to provide training and retraining of the necessary number of specialists for the country, and even more so – to meet the needs of all those wishing to study.

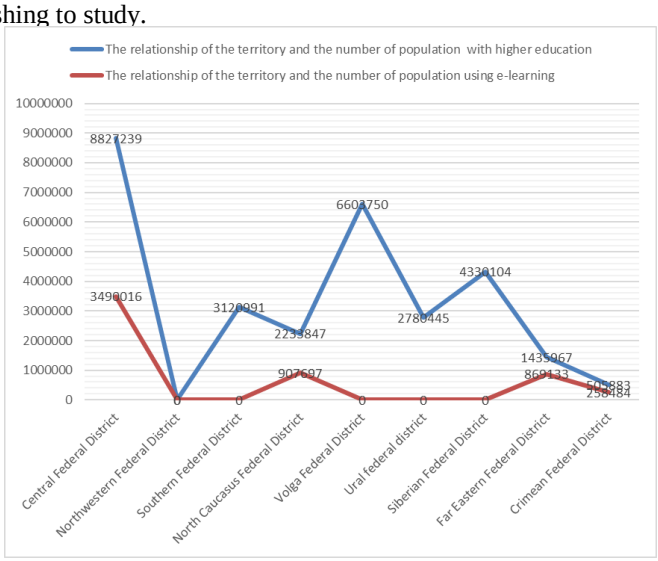

Fig. 1. The relationship of the territory and the number of population with higher professional education and using e-learning in the regions of the Russian Federation for 2018

The output is seen in the study of the latest educational technologies and their gradual introduction into the educational process of higher education. Distance learning is provided by the use of a set of educational technologies in which the indirect purposeful or not fully indirect interaction of the student and the teacher is implemented regardless of their location and time on the basis of pedagogically organized information technologies, primarily using telecommunications.

The definition of distance learning technology should be based on the analogy of a detailed definition of social technologies. Guided by this, the technology of distance learning is defined in our study as a specific method of implementation of teaching activities to achieve educational goals in mediated or not fully mediated interaction of subjects; the essence of the method is the rational division of activities into procedures and stages with their further coordination and synchronization; this division is carried out previously, consciously and systematically on the basis and using the best practices of pedagogy and related sciences, and scientific knowledge.

In addition, the method of distance learning comes in two forms: a program of action comprising operations and procedures and activities based under that program. In this presentation, the technology of distance learning can be considered as a system of evidence-based guidelines prescribed for the implementation and application in educational practice, i.e. as a pedagogical technology of learning. In this case, the core of such technology, from our point of view, should be the following elements in the relationship: means, methods, forms of education (for the implementation of a given content of education). So, the definition of distance learning technology can be given as follows: the system of methods, specific means

and forms of education for the distributed implementation of a given content of education, i.e. distance learning technology is a pedagogical technology.

At the mathematical description the amount of knowledge of the pupil is considered as the flow of information circulating in the "teacher-the subject of training" system and usually is expressed as the integro-differential equations. On their basis a number of practical examples is solved, and recommendations about optimization of process of distance learning, for example, on distribution of an academic load during the set training time become. Such formalization of process of formation of knowledge allows to provide, in particular, graphic creation of so-called curves of training.

On the basis of the analysis of the coefficients characterizing process of training, entering analytical dependences it is supposed to reveal possibilities of improvement of the existing models for the purpose of obtaining mathematical dependence, more precisely corresponding to features of process of assimilation of knowledge. Various mathematical models of process of training consider such parameters of educational process as speed of assimilation of a training material, forgetting and motivation.

The equations describing dynamics of process of distance learning have an appearance:

$$(1)\begin{cases}\dfrac{\mathrm{d}T}{\mathrm{d}t}=\left(MN(t)+\beta A(t)\right)\left(1-\dfrac{T}{TMAX}\right)T\\ \dfrac{\mathrm{d}N}{\mathrm{d}t}=\delta\left(\acute{N}-N\right)-zT\\ \dfrac{\mathrm{d}A}{\mathrm{d}t}=bq(t)+kA\end{cases}$$

T – the volume of the acquired educational information for a period,

N – characterizes the level of distribution of remote forms of education,

A – the volume of a motivational component of distance learning.

In turn this system of the equations includes:

q – volume remotely the broadcast educational information for the same period;

b– speed of change of amount of knowledge of the student;

k – constant speed of a forgetting;

δ – the constant speed of development of a system of remote education;

z – constant growth rate of level of qualifying standards;

TMAX - is some extreme volume of the acquired educational information.

M and β – coefficients determine a ratio between the volume of the educational information which is subject to assimilation and the volume of a motivational component of educational information.

In this model understand the educational information provided in a special way containing the didactic elements stimulating educational activity as a motivational component of educational process and capable to raise degree of motivation of the subject of training.

Considering that

$$D(0)=A(0) \quad (2),$$

let's submit the solution of the lower equation of a system (1) in shape:

$$A(t)=\mathrm{e}^{-kt}D(t) \quad (3)$$

Подставив (3) в нижнее уравнение системы (1), получим уравнение для $D(t)$:

$$\frac{\mathrm{d}D}{\mathrm{d}t}=b\mathrm{e}^{kt}q(t) \quad (4)$$

The solution to this equation is:

$$D(t)=A(0)+b\int_0^t \mathrm{d}\theta^{e^{-k(t-\theta)}}q(\theta) \quad (5)$$

Let's consider volume remotely the constant broadcast to educational information: : $q-q_0, then:$

$$1-e^{-kt}$$

$$A(t)=A(0)\mathrm{e}^{-kt}+b\mathrm{e}^{-kt}\int_0^t \mathrm{d}\theta\mathrm{e}^{K\theta}qo=A(0)\mathrm{e}^{-kt}+\frac{bq_0}{k} \quad (6)$$

Let's rewrite the average equation of a system (1) in shape now:

$$\frac{d}{\mathrm{d}t}\left(\acute{N}-N\right)=v\left(\acute{N}-N\right)+zT(t) \quad (7)$$

Also we will look for its decision in a look:

$$\acute{N}-N(t)=B(t)\mathrm{e}^{-\delta t} \quad (8)$$

Having substituted expression (8) in the equation (7), we will receive the equation for the *B(t)* function:

$$\frac{\mathrm{d}B}{\mathrm{d}t}=z\mathrm{e}^{\delta t}T(t), \quad (9)$$

Substituting its decision:

$B(t)=B(0)+z\int_0^t \mathrm{e}^{v\theta}T(\theta)\mathrm{d}\theta$ in expression (8), we will receive expression for the N(t) function:

$$N(t)=\acute{N}-\left(\acute{N}-N(0)\right)\mathrm{e}^{-vt}-z\int_0^t \mathrm{e}^{-v(t-\theta)}T(\theta)\mathrm{d}\theta \quad (10)$$

Let's address studying of the first equation of a system (1) now, at the beginning of a cycle of distance learning conditions are satisfied: $T<<TMAX, t<<t_k-t_H$ where t_k is the end of the cycle, and t_H is the beginning of the cycle of distance learning.

Therefore, at the beginning of a cycle of distance learning:

$N(t)\approx\acute{N}, A(t)\approx A(0)$.

and, therefore, the feather equation of a system (1) has an appearance:

$$\frac{\mathrm{d}T}{\mathrm{d}t}\approx\left(MN+\beta A(0)\right)T \quad (11)$$

Solution of the equation (11):

$$T(t)=exp\left\{\left(M\acute{N}+\beta A(0)\right)t\right\}T(0) \quad (12)$$

demonstrates that during an initial stage of a cycle of distance learning the exponential growth of volume of the

acquired educational information is observed. In a final stage of a cycle of distance learning ratios are carried out:

$$A \approx \frac{bq_0}{k}, N \approx \acute{N} - z\frac{TMAX}{v}, T \approx TMAX .$$

Taking into account these ratios the first equation of a system (1) takes a form:

$$\frac{\mathrm{d}\left(T - TMAX\right)}{\mathrm{d}t} = \\ = -\left(M\left(\acute{N} - z\frac{TMAX}{v}\right) + \frac{\beta bq_0}{k}\right)\left(T - TMAX\right) \quad (13)$$

The decision (13) has an appearance:

$$T(t) = TMAX + \\ + \left(T(0) - TMAX\right)exp\left\{-\left[M\left(\acute{N} - \frac{z\left(TMAX\right)}{v}\right) + \frac{\beta bq_0}{k}\right]t\right\} \to TMAX$$

Thus, the level of distribution of remote forms of education is characterized by a ratio:

$$a\acute{N} > \frac{zTMAX}{a} .$$

So, we can draw undermentioned conclusion.

III. Conclusions

The study determined that any model of the process of training an IT-specialist in the application of distance learning technologies provides:

- flexible combination of cognitive independent activity of those who wish to study with a variety of sources of information, training materials, specially designed for any course;
- prompt and regular interaction with the leading teacher, consultants, coordinators;
- group work on the type of training in cooperation (cooperative learning) with the participants of this course, using a variety of problem, research, search methods in the process of working on the relevant modules of the course;
- joint telecommunication projects of the course participants, organizing discussions;
- presentations of groups and individual presentations of intermediate and final results during electronic teleconferences, exchanging views, information with the participants of the course, as well as, if necessary, with any other partners via the Internet.

Personification of education based on modern Information and Communication Technologies will be able to solve an important contradiction of the modern economy – the need for mass retraining of millions of people and the practical lack of modern tools for this. For the development of computer training systems that ensure its personification, it is necessary at least to be able to measure the process of mastering the material and the complexity of tasks. The experiments on real data allow us to conclude that it is possible to develop such systems.

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