Innovative Approaches to the Organization of Students' Independent Learning in Accordance with the Digital Economy Requirements

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Abstract

The demands of the digital economy raise new challenges for the education system. Under these conditions, the effective organization of the educational process requires new approaches, focusing on the students' independence and their responsibility. This article deals with the problem of modernization and quality assurance of modern Russian education through the use of modeling as a method of pedagogical research. The developed model of organization of students' independent learning in the information and communication educational environment is presented. The stages of formation of the student's independence degree in various types of lessons, implemented using active methods and interactive learning tools, are singled out. The basic factors and pedagogical conditions for increasing the effectiveness of independent learning in the information and communication educational environment are formulated. The step-by-step formation technology of the degree of self-reliance, taking into account the readiness of students for independent learning and the use of information and communication technologies, is proposed. The stages of the independent learning organization stimulate individual activity, contribute to the development of the student's interest in the studied material, develop the ability and need for self-knowledge, resulting in a higher level of independence and self-assessment of students. The efficiency of the developed model of the organization of students' independent learning in the information and communication educational environment has been proved experimentally. Its use allows personifying and substantially intensifying the learning process, increasing motivation and more objectively revealing the abilities of each student.

Keywords: digital economy, digitalization of education, modeling in pedagogical science, students independent learning, information and

communication educational environment, active teaching methods, interactive learning tools.

1   Introduction

Currently, one of the trends in social development is the digital transformation of virtually all spheres of society. One of the five basic ways of the digital economy development in Russia for the period up to 2024 includes "Personnel and education" [**Ord17**].

The transition process to a digital economy imposes special requirements not only on the level of future specialists competences formation but also on the level of their individual and personal development, intellectual and social mobility. The formation of new ways of human interaction with the digital world involves major changes in the education system [**Kup17**, **Yav19**].

"The Strategy of the Russian Federation Scientific and Technological Development" identifies the factors that determine the need for advanced development of education in the transition to the digital economy: a sharp reduction in the time between the production of new knowledge and the creation of new production technologies on their basis; deepening interdisciplinary and transdisciplinary nature of research;

As a result of the digitalization of education, the learning process becomes more flexible, each student personal characteristics are taken into account. Student himself creates a request for knowledge and is included in the learning process at a convenient time.

Digitization of education allows implementing the concept of lifelong learning, which is one of the ways to respond to the challenges of the digital economy. However, to develop and improve future specialists skills and abilities demanded in the digital economy, we need more effective organization models of the educational process and student's independence learning. Traditional teacher-oriented learning is not able to develop these new skills.

Discussions about the validity of modeling in pedagogy are conducted in the scientific community for a long time. However, according to some teachers-researchers [**Lod10**, **Osi15**, **Fra14**], modeling in pedagogical science is not paid enough attention. This is one of the reasons for the inefficiency of modern Russian education.

In solving this problem, in our opinion, a special role is played by computer modeling of the educational process. The harmonious interaction of intellectual abilities of a person and computer technology can lead to a qualitatively new stage of intensification and optimization of multi-faceted pedagogical activity.

Any model building of learning should be based on existing didactic theories or concepts. Authors in their works formulated the main provisions of computer pedagogical modeling:

1. entering into the process and choice of methodological grounds for modeling, qualitative description of the subject of research;
2. formulation of modeling problems;
3. model building with clarification of the relationship between the basic elements of the object, the determination of the object properties and the criteria for assessing changes in these properties, the choice of measurement methods;
4. study of model validity in solving the problems;
5. the use of the model in the pedagogical experiment;
6. meaningful interpretation of the simulation results.

2   Task

The requirements of the digital economy and the introduction of new federal state educational standards for higher education determine the need to change the content of training but also approaches to the search for forms of the educational process organization, which provide for strengthening the role and continuous optimization of student's independent learning (SIL). In this regard, the issue of creating an educational environment based on information and communication technologies, focused on the student's independent learning, is actualized.

Information and communication educational environment (ICEE) has the necessary didactic potential, is a technological basis, an integral component of the modern learning system and initiates a change in the whole pedagogical system. However, it remains an open question about the use of information educational environment for the implementation of effective independent learning.

The organization of students' independent work in information and communication educational environment (ICEE) will be more successful in comparison with the existing practice, if:

– a model for organizing students' independent learning in ICEE is proposed and implemented, allowing to implement active and interactive methods, taking into account the readiness of students for independent learning and the growth of their independence;

– the pedagogical conditions for the implementation of effective students' independent learning in ICEE and the fundamental factors influencing their active use by the subjects of the educational process in independent learning are taken into account.

3   Development of methodology

The use of modeling is closely connected with the deeper knowledge of the essence of teaching-educational phenomena and processes, enhancement the theoretical foundations of the study. A teacher-researcher can develop models: optimization of the structure of the educational process, activation of cognitive independence of students, person-oriented approach to students in the learning process, etc. We have developed the model of organization of students' independent learning in the information and communication educational environment (Fig. 1), represented by blocks of classroom and extracurricular independent learning, in accordance with the selected stages (adaptation, forming, final) of the formation of the degree of independence. The organization of the SIL is carried out in various types of classes, which are implemented using active methods and interactive learning tools [**Osi15**, **Kul17**].
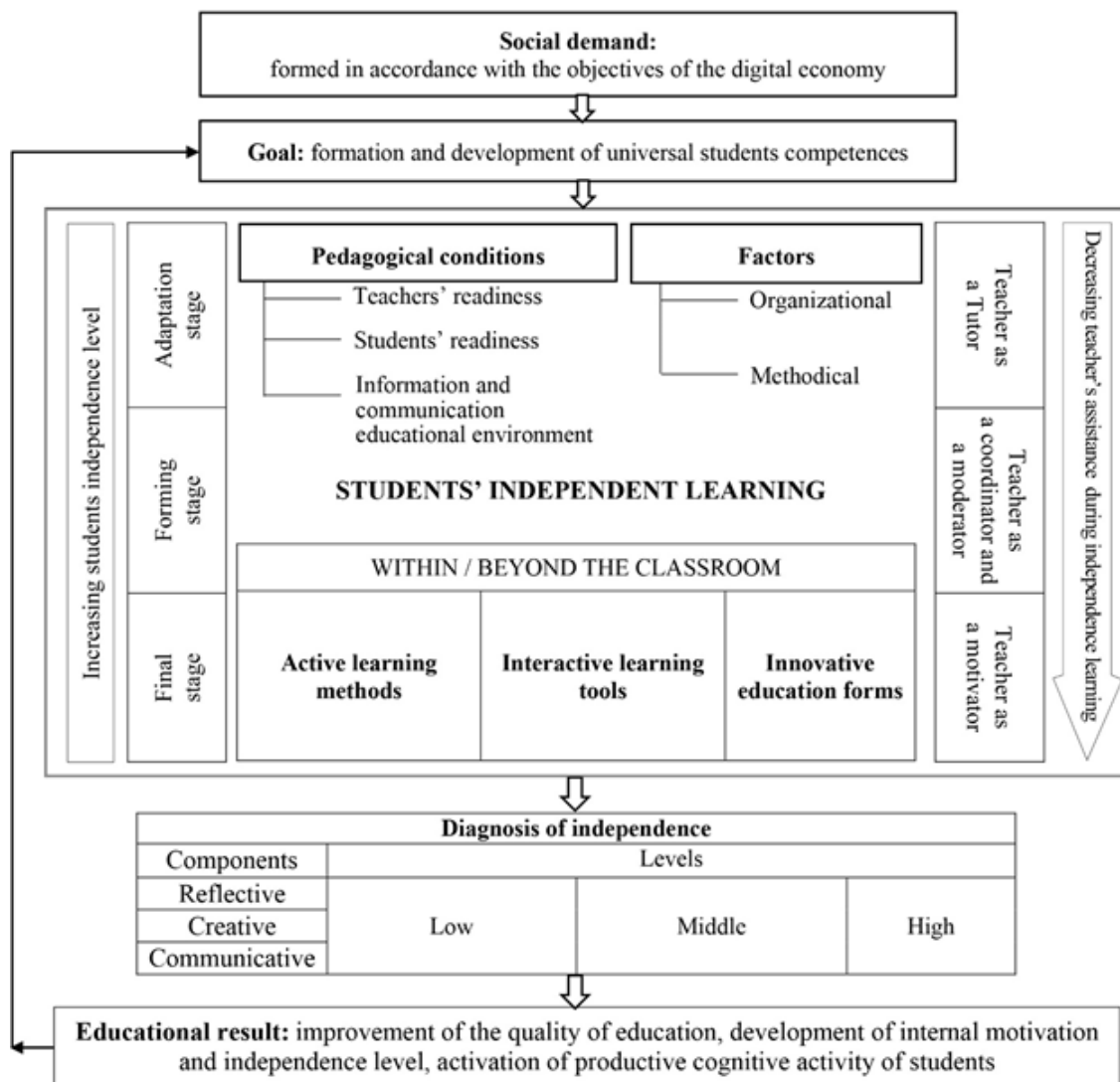

Fig1. Model of organization of students' independent learning in ICEE

The analysis of scientific literature allowed us to determine the fundamental factors (organizational, methodological) and pedagogical conditions (Fig. 1) of effective independent learning in ICEE:

- readiness of the teacher (motivational, technological, psychological and pedagogical components) to use information and communication technologies (ICT) in the organization of independent learning of students, taking into account the formed independence degree;
- readiness of the student (motivational, cognitive, technological components) for independent learning and use of information and communication technologies for effective implementation;
- availability of a specially designed information and communication educational environment, which is block-modular and open in nature and allows to implement active teaching methods (telecommunication project, webinar, blog discussion, heuristic chat conversation, etc. [**Zen18**, **Has19**]) in the independent learning of students.

The implementation of the proposed model at various stages, taking into account the increasing degree of independence, is based on the use of active methods of learning with the use of ICT.

The approach we used in the development and implementation of the model of organization of independent learning in the ICEE, has a certain uniformity and is considered by us as a pedagogical technology.

Under the technology of independent learning of students, we mean a goal-directed and personally-oriented process of subject-subject interaction between the teacher and the student, during which the teacher, taking into account the students' readiness for independent learning, motivational-value relations, uses active teaching methods applying ICT and various types and forms of tasks for independent learning, means developed by ICEE, improves the quality of education, develops the degree of independence and enhance the students' productive cognitive activity . For the organization of the SIL, based on a personality-oriented approach, using ICEE as a tool, a technology for the gradual formation of the independence degree, taking into account the students' readiness for independent learning and the use of information and communication technologies is proposed [Kul19] .

Let's consider the technology of the SIL at each stage in more detail. The adaptation stage involves the organization of first-year students' independent learning who have different degrees of readiness for it and a level of knowledge of information and communication technologies. Therefore, for the effective organization of the SIL, the teacher needs to identify the level of students' basic cognitive skills and information culture (with the help of questionnaires, tests, observations), i.e., to determine the students' readiness to use ICT in independent learning. The formation of new knowledge begins at the lecture, which, being the main element of the didactic cycle of education, is responsible for the systematic work during the semester and is the leading form of the educational process, providing the scientific level of students training.

At the adaptation stage, it is advisable to use the following types of lectures to stimulate the cognitive activity of students: lecture-conversation, lecture of a problem nature, lecture using of feedback.

Practical training at the adaptation stage begins with the input control of knowledge. If the input control is not passed, students are offered to repeat the study material using the theoretical block ICEE. Upon successful passing of the input control, the student goes to the independent execution of tasks in the ICEE using the module "Self-study".

The module "Self-study" offers students the tasks that they perform in a notebook or, using the software, enter the received answer into the provided field. If the answer is correct, the student moves to a new task, and if the answer is incorrect, then the students are offered a three-level help [**Osi15**]. After fulfillment all the tasks provided for the topic under study, a report window is displayed, which indicates the total number of viewed tasks, the number of tasks, the answers to which were given: true; without a hint; with a hint and wrong. This organization of work allows students to independently learn to solve problems, to assess the degree of their training, and the teacher – to monitor the progress of students and, if necessary, to adjust their training, providing individual advice.

The program "Self-control of knowledge" is used to carry out self-monitoring in practical classes. The program "Self-knowledge" offers a selection of tasks for each topic, that are recommended to solve the student. The solution of each task is given a certain time, if necessary, the time can be turned off. The student solves the problem in a notebook or, using software, chooses the correct answer. The program reports the correctness of the solution of this problem every time. After all tasks are completed, the percentage of correctly completed tasks is reported. Then students are given the opportunity to view incorrectly solved problems with the correct answers and correct mistakes [**Sil17**].

The out-of-class SIL at the adaptation stage takes place in the form of a discussion of lecture issues at the forum and in the chat. One of the main priorities of the teacher is to create a cognitive, creative atmosphere

in the classroom, stimulating the interest of students to self-acquisition of knowledge, organization of communication and cooperation of students for collective solutions to common problems. At the same time, the main functions of the teacher depend on the degree of students' independence and range from information-controlling to consultative-coordinating, which can be carried out both in real and remote mode. At the adaptation stage, the teacher, being a motivator, organizes the ICEE-based SIL, advises, corrects the independent learning process, controls the results. The main goal of the teacher at this stage is to teach the student to learn.

The technology of the SIL organization at the forming stage involves the use of a greater variety of active types lectures (lecture-discussion, lecture with pre-planned errors, problem lecture). It should be noted that such forms of lectures at the same time perform educational, stimulating and control functions, helping to diagnose the difficulties of mastering the previous material [**Kul18**].

The function of the teacher, in this case, is aimed at developing the student's potential and his abilities. The teacher organizes the process of free communication, leading the student to make a decision, creates an atmosphere of cooperation.

At the practical lesson of the forming stage, depending on the topic studied, imitation and non-imitative methods of organizing the SIL are used. The practical lesson with the use of non-imitative methods begins with the same input control, the successful completion of which allows the student to go to the independent implementation of the practical task with various types of didactic materials (differentiated tasks, demo presentations), presented in the form of technological maps of three-level assistance. We have noted that for 80% of students there are enough maps of the first and second level. After completing the practical task, students move on to self-control, which is carried out with the help of the same program "Self-control of knowledge", as in the adaptation stage.

Currently, the amount of hours for independent learning of the discipline is increasing, in this regard, the issue of using network technologies in the practice of full-time education becomes urgent. At the forming stage, the use of network technologies is expanding.

Network technologies, such as blogs, e-mail, newsgroups, web forums and chats, become the basis for conducting SIL, because they are used both to provide students with educational and methodical materials and for interactive collaboration between the teacher and the student [**Lea08**, **Jon15**]. The use of the blog in the learning process has a number of advantages over other network technologies, as it creates an opportunity to publish reviews, provides network communication environment.

Among the educational blogs we can identify:

Personal blog – an educator shares the methodological experience, useful for colleagues references, reflexes about the lessons, summarizes the experience, creates an electronic portfolio.

Project support blog organizes the work on the educational project in extracurricular time (tasks, information about the stages of its implementation, reports and creative work of students are placed here).

Collective blog arranges the work of the network community. To enhance the educational functions of the blog, to expand its functionality allows the use of widgets and gadgets. Their use greatly simplifies the work with information, making it more visible and accessible to the perception, reduces the time spent on obtaining and processing information, i.e. provides students with the necessary tools for the successful completion of tasks. Using the blog allows you to organize the following forms of independent learning: on-line seminar, execution of tasks with subsequent discussion in the network. At the on-line seminar, the issues that have been submitted for self-study are discussed.

Execution of tasks with subsequent discussion in the network are implemented as follows. Students are given independent learning, which they have to do and put in their folder on the blog. For the teacher, the students posted works is one of the forms of control, the ability to draw conclusions about how students transform and assimilate the information. Organizing a discussion allows you to make a collective decision online during the discussion.

The final stage is characterized by a good students readiness for independent learning, as a result, lecture-teleconference is added to all types of lectures discussed at the previous stages.

Independent learning in a practical lesson is also carried out using non-simulation and simulation teaching methods.

Implementation of practical tasks using non-simulation methods begins, as in the previous stages, from the input control of knowledge, the successful completion of which allows students to move to independent learning with cases or attachable modules.

Working with the case, students, having studied the necessary part of theoretical material, which is well structured, with convenient navigation, after examining the examples, begin to solve tasks, choosing at their

discretion the level of complexity. When developing tasks for self-completion using ICEE, emphasis is placed on the individual work of students with well-prepared structured educational material. A distinctive feature of independent learning at this stage is that for its implementation, there are no three-level help cards containing detailed instructions and step-by-step algorithms for solving tasks.

Such approach is effective, as the student not only absorbs information, but joins an active cognitive process, accompanied by the formation of techniques and skills of independent mental activity.

Self-monitoring and ongoing monitoring at this stage are similar to the previous stages.

At this stage, independent learning is organized by the same imitation methods as at the forming stage (telecommunication project, role-playing game, project work). A distinctive feature of the SIL at the final stage is that students are not only participants of webinars and solve tasks posted on the blog, but also are moderators of teaching forums and developers of educational blogs, thus reducing the management of students by the teacher. At this stage, the teacher-tutor provides educational support of the SIL, gives advice, together with the student discusses and corrects the results of their independent learning, using the ICEE, evaluates the activity of the student.

The proposed stages of the organization of independent learning stimulate individual activity, contribute to the growth of student interest in the study material, develop the skill and need for independent knowledge acquisition, resulting in increased level of students' independence, reduced management of the SIL and the provision of assistance from the teacher and ICEE.

The use of the reviewed ICEE allows the realization of such evolving learning goals as the development of thinking, the formation of the skills to make the best decision from possible options, the development of skills to carry out research activities, the formation of an information culture, and the ability to process information. Such an organization of the SIL, in our opinion, allows personifying and significantly intensifying the learning process, increasing motivation and more objectively revealing the abilities of each student.

In the process of learning, the degree of independence varies among students, and thus the teacher must consider the organization of the SIL as a whole, taking into account the students' readiness for independent learning, the formation and growth of their degree of independence.

To diagnose the effectiveness of the technology of independent learning, we determined the following indicators: independence and self-assessment. To assess the independence, we have identified the following parameters: communicative, creative and reflective components.

To determine the communicative component, we evaluated the student's independence and active use of network technologies in the process of independent learning.

Under the student's independence, we mean the ability of the subjects to independently carry out their educational work, actively and consciously manage it, to accumulate individual experience, exercising self-control and self-correction. The degree of independence is optimal, if the student solves the task completely independently; the degree of independence is middle, if the task is solved by the student partially independently (asks for help from the teacher or other students), the degree of independence is low, if the teacher's help prevails.

The activity of using network technologies is also evaluated by three criteria: optimal (is an active participant), middle (systematically participates), low (occasionally participates).

Literature analysis [**Lod10**, **Kul15**, **Kul12**] allowed to distinguish the criteria of the creative component of the cognitive independence level: reproductive, reconstructive, search.

The low level of independence corresponds to the reproductive level, when the student acts on the model.

The middle level is a reconstructive one, a student on the basis of his own deductive methods, extracts new information, applying the acquired knowledge to solve non-standard problems.

The optimum level is creative, independent activity acquires a search character in terms of transferring knowledge at the conversion level of the previously learned programs activities for creative problem solving and discovering the principles of solutions leading to produce objectively new information. Reflection in the course of independent learning can be considered from two positions:

1) the student returns to the stage of independent learning planning and analyzes its individual components;

2) the student analyzes the correlation of his own capabilities and external conditions.

Analysis of psychological and pedagogical literature [**Song12**, **Rean08**] allowed to draw the following conclusion: a sign of low development of reflection is the lack of a student's desire to analyze the process and result of independent learning. A sign of well-developed reflection (middle level) is the student's search for ways to improve independent learning, the desire to improve its efficiency. The optimal development of reflection involves the creative search for ways to improve independent learning.

4   Results

Diagnostics of the independence level was carried out twice: at the beginning and at the end of the discipline study using the proposed independent learning technology at different stages, in the same students.

x^2 - criterion was applied to the obtained quantitative data to evaluate the results of the experiment. This criterion allows comparing the percentage distributions of the data [**Song12**, **Rean08**]. The boundary value of the x^2 - criterion corresponding to two degrees of freedom and the probability of an acceptable error 0.05, obtained in the experiment, is 5.99, which allows us to conclude about significant changes in the progress of the independence degree and confirms the effectiveness of the developed model. The dynamics of the development of students' independence at the final stage of education is shown in fig. 2.
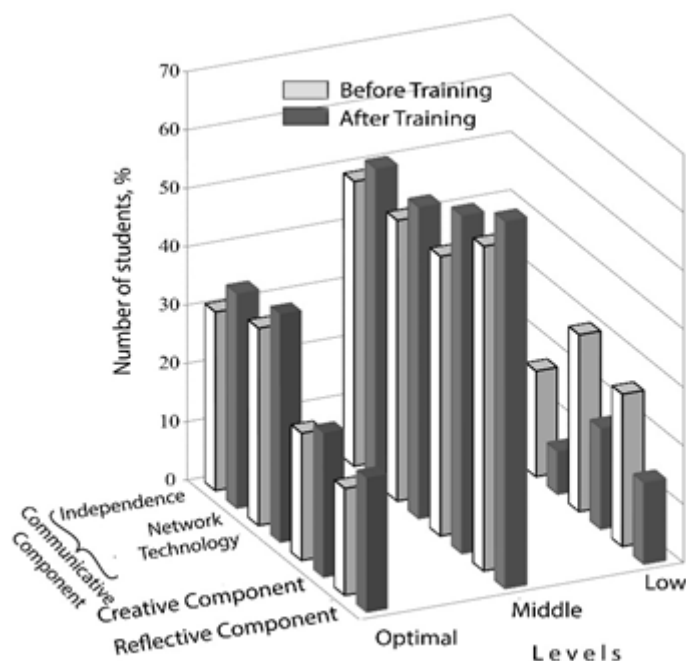

Fig2. Independence Level on the Final Stage of Education

The self-assessment study was carried out using the ranking procedure. The comparison of students' self-assessment results with the results obtained during the experiment allowed to conclude that the use of the proposed technology of independent learning forms an adequate self-assessment of students (attitude to independent learning and the degree of independence) [**Ker 19**]. The use of students' self-assessment in the process of pedagogical experiment makes it possible to put emphasis in the educational process on the individual self-development, the development of skills in planning independent learning, self-correction, self-control.

The further solution of the mentioned problems opens up opportunities for deepening the experimental research of such areas as the organization of students' independent learning of university with the extensive use of ICT-based information and communication educational environment in various disciplines in the process of full-time and distance learning.

5   Conclusion

Training of future specialists for professional activity should combine development of competences and improvement of the personal characteristics that are essential for academic success. Independence is one of the most important personal qualities which affects students' learning process, it aids to develop into active and productive members of society, ensures the effectiveness and quality of teaching, helps to develop creative way of thinking and self-education skills.

On the one hand, the students' independence in the learning practices is a form of organization of their educational activity, carried out under the direct or indirect guidance of a teacher in ICEE, during which students predominantly or completely independently perform tasks with various levels of difficulty to develop competencies

and personal qualities. On the other hand, we consider independence as an internal, stable personality quality and the ability to acquire knowledge independently within or beyond the classroom.

The implementation of suggested block-modular model of the organization of students' independent learning based on the ICEE helps to adopt a holistic approach to independent learning within or beyond the classroom. The model takes into account different levels of students' independence development at each stage of training during university education. The use of the proposed technology at the indicated stages activates the productive cognitive activity of students, prepares them for continuing education and self-education.

The results of pilot training based on the suggested block-modular model have shown that the implementation of the proposed technology at each stage of the training leads to decreasing teacher's assistance during independence learning, improves the quality of education, the development of internal motivation and adequate self-assessment, provides opportunities for enhanced and more effective independent learning.

The developed approach to the organization of students' independent learning can and should be used in mass educational practice as a promising direction for improving the quality of education in accordance with the requirements of the digital economy.

References

[Ord17] Order of the Government of the Russian Federation of 28.07.2017 N 1632-r «On the approval of the program "Digital Economy of the Russian Federation" Electronic resource. URL: http://static.government.ru/media/files/9gFM4FHj4PsB79I5v7yLVuPgu4bvR7M0.pdf

[Kup17] V. Kupriyanovsky etc. Skills in the digital economy and the challenges of the education system / Kupriyanovsky V., Sukhomlin V., Dobrynin A., Raikov A., Shkurov F., Drozhzhinov V., Fedorova N., Namiot D. // International Journal of Open Information Technologies. – 2017. – Vol. 5, no. 1. – P. 19–25.

[Yav19] M.A. Yavorskiy, I.E. Milova, V.V. Bolgova. Legal Education in Conditions of Digital Economy Development: Modern Challenges. Advances in Intelligent Systems and Computing, 908, pp. 455-462, 2019.

[Lod10] E. A. Lodatko. Modeling pedagogical systems and processes. SGPU, Slavyansk, 2010.

[Osi15] S. I. Osipova. Mathematical Methods in Pedagogical Studies. Siberian Federal University, Krasnoyarsk, 2015.

[Fra14] J. Fraillon, J. Ainley, W. Schulz, T. Friedman, E. Gebhardt. The Contexts for Education on Computer and Information Literacy. In: Preparing for Life in a Digital Age. pp. 47-67. Springer, Cham, 2014.

[Kul17] T. A. Kulikova, A. Yu. Dyachenko. The Organization of the Students' Learning Activity Using Interactive Training Tools. Kant 2(23), pp. 42-45, 2017.

[Zen18] S. V. Zenkina, O. P. Pankratova, E. A. Konopko, A.H. Ardeev. Model of organization of network project-research students activities in collaboration with city-forming enterprises // Integrating Research Agendas and Devising Joint Challenges International Multidisciplinary Symposium ICT Research in Russian Federation and Europe. 2018. C. 290-296.

[Has19] R. Hasan, S. Palaniappan, S. Mahmood, B. Shah, A. Abbas, K.U. Sarker. Enhancing the Teaching and Learning Process Using Video Streaming Servers and Forecasting Techniques 11 (7). Sustainability (Switzerland), 2019.

[Kul19] T. A. Kulikova, N. A. Poddubnaya. Tools for the Implementation of Distance Learning Technologies. Standards and Monitoring in Education (vol. 7) 1, pp. 32-35, 2019.

[Sil17] S.G. Silverajah, A. Govindaraj. The use of Digitized Self-Learning Resources to Enhance Students' Independent Learning. ACM International Conference Proceeding Series, pp. 131-135, 2017.

[Jon15] A. H. Jonsdottir, A. Jakobsdottir, G. Stefansson. Development and use of an adaptive learning environment to research online study behavior. Educational Technology and Society 18(1), pp. 132-144. 2015.

[Kul18] T. A. Kulikova, N. A. Poddubnaya. AR Technology in the Educational Process of the University. Herald of Tver State University. Series: Pedagogy and Psychology 4, pp. 252-256, 2018.

[Jon15] A. H. Jonsdottir, A. Jakobsdottir, G. Stefansson. Development and use of an adaptive learning environment to research online study behavior. Educational Technology and Society 18(1), pp. 132-144. 2015.

[Ren08] A. A. Rean. Psychology and psycho-diagnostics of personality. Prime-Euroznak, Saint-Petersburg, 2008.

[Ker 19] D. Keržič, A. Aristovnik, N. Tomaževič, L. Umek. Assessing the Impact of Students' Activities in E-courses on Learning Outcomes: a Data Mining Approach. Interactive Technology and Smart Education, 2019.