Formation of Digital Literacy of Students by Means of Virtual and Augmented Reality Technologies

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Abstract

The relevance of the problem under study is due to the fact that according to the adopted national program "Digital economy of the Russian Federation", it is necessary to provide training of highly qualified personnel who are able to apply promising information technologies, have a high level of digital skills and competencies that meet the social order and requirements of the digital economy. Based on these requirements, there is a need for the formation of digital literacy of students by means of virtual and augmented reality, which contributes to the development of constructive thinking in the young generation, interest in technical types of creativity and engineering areas of training. Basic schools of the Russian Academy of Sciences serve as a means of creating optimal conditions for identifying and working with talented young people who are focused on careers in science and high technologies. Support of the RAS basic school in Stavropol is implemented by the North Caucasus Federal University, which was offered several priority project areas for students, in particular, "Virtual and augmented reality". For this purpose, the technology of forming digital literacy of students by means of virtual and augmented reality has been developed, and its effectiveness has been shown.

Keywords [1]

Digital literacy, Basic schools of the Russian Academy of Sciences, project activities of students, virtual and augmented reality technologies, immersive environment, visualization tools for virtual objects.

1. Introduction

The key task of education is to create decent conditions for the growth of human potential, personal development and the sustainable formation and development of skills in demand in the context of economic and cultural dynamics.

According to the goals and objectives formulated in the All-Russian Program "Digital Economy of the Russian Federation", the process of modernizing the education system should be aimed at training personnel with the competencies of the digital economy, at creating a motivation system for mastering the necessary competencies [1].

Analysis of the data of the annual all-Russian research ROCIT "Index of digital literacy of citizens of the Russian Federation" showed its decrease in the population in 2019 compared to the previous period. This actualizes the problem of increasing the level of digital literacy of students, requirements for graduates in educational institutions in accordance with the tasks of modernizing education, the main subject of which would be the students themselves.

In addition, there is a lack of highly qualified young personnel in Russian science. Therefore, a holistic and systematic approach to training such personnel is required, starting from the level of

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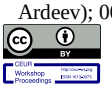

general education. The development of schoolchildren's research skills, creative thinking, and the ability to solve extraordinary scientific problems in the field of digital technologies indicate the need to create special conditions. To solve this problem, it is advisable to involve scientists and teachers from various research centers and universities.

In this regard, the Russian Academy of Sciences has developed a Concept for the creation of basic schools of the Russian Academy of Sciences in accordance with the instructions of the President of the Russian Federation dated December 28, 2018.The goal of these schools is "to create the most favorable conditions for identifying and teaching talented children", focused on a career in the field of science and high technologies. That "will serve the development of the intellectual potential of the regions and the country as a whole."

The main criterion for the selection of educational organizations is the place in the ranking of the best schools in Russia, which is determined by the high achievements of students in subject Olympiads and competitions, including international ones, the results of passing the Unified State Exam and the admission of graduates to leading universities in Russia.

In accordance with these criteria, Gymnasium No. 25 and Lyceum No. 14 were selected in Stavropol, and the North Caucasus Federal University was chosen as the organization that will support the basic school.

The North Caucasus Federal University proposed several priority project areas for students, one of which is "Virtual and Augmented Reality". These modern technologies, allowing to explore completely immersive computer worlds (VR technology) and superimpose visual objects on the surrounding reality (AR technology), are increasingly used not only in the entertainment industry, but also in the digital industry and educational space.

The use of VR / AR technologies in digital production allows for the modernization of various technological processes and the use of VR / AR tools in the following areas:

• learning with the help of immersive environments: the specialist is immersed in a virtual environment, where he makes decisions, being in a safe digital environment;

• design and assembly: determine the ability to create digital models and research equipment operations, testing and modifying this model before creating a prototype;

• testing and quality assurance: equipment verification using visualization tools, interactive monitoring.

Currently, the process of introducing VR / AR technologies into the learning process of many Russian educational institutions is being actively carried out. Despite some obstacles, interest in modern technologies is constantly growing both among teachers and among students themselves. This is due to the fact that the positive aspects of using virtual and augmented reality in teaching include the effects of immersion and presence, focus, interactivity, etc. In addition, the number of studies that prove the educational value of methodologically verified VR / AR developments is increasing [2].

It should be noted that a clear line must be drawn between learning in virtual reality and learning in virtual reality. In the first case, VR is not an end in itself, it is only an additional tool in teaching a subject, the same as a textbook, interactive whiteboard or mobile application. In the second case, students acquire a new skill of working with technology: they learn 3D modeling, programming, system administration, user interface design, etc. and use platforms such as Unity, Unreal Engine, etc.

2. Goals and objectives of the study

The aim of the study is to develop and test the technology for the formation of digital literacy of students by means of virtual and augmented reality, which contributes to the development of constructive thinking in the younger generation, interest in technical types of creativity and engineering areas of training.

To achieve this goal, the following research tasks were solved:

1. Determine the scientific and didactic foundations for the formation of digital literacy of students and the didactic possibilities of virtual and augmented reality technologies for its optimization.
2. Develop a technology for the formation of digital literacy of students by means of virtual and augmented reality.

3. Check the pedagogical effectiveness of the implementation of the developed technology in the educational process.

3. Analysis of literature

Summarizing the research results concerning the use of digital tools in various fields of professional activity, as well as the problems of informatization and digitalization of the educational process, it can be argued that the concept of "digital literacy" is quite widely used in both domestic and foreign pedagogy [3].

The concept of "digital literacy" as a system of cognitive, social and technical skills that allows a person to interact in a digital environment and work with various information resources was proposed at the beginning of the XXI century by foreign researchers such as M. Varshaver and T. Matuchnyak, A. . Martin, P. Gilster, E. Hargitai, G. Jenkins and others).

In the future, digital literacy began to be understood as a more complex concept consisting of various components, such as: computer literacy (the ability to work with PC hardware and software), information literacy (skills and knowledge of working with information), media literacy (skills in working with media information) and network literacy (the ability to apply network technologies).

Thus, G. Jenkins et al. Believe that for the formation of digital literacy, it is necessary to develop three types of skills:

• skills in using computer hardware;

• skills in working with software that supports various types of content;

• universal skills in the use of digital technologies in daily activities, including modeling and design of digital resources [4].

D. Belshaw examines various models of the concept of "digital literacy" and identifies the main components (cultural, cognitive, constructive, communicative, critical, civic, confident use and creativity) of human digital interaction with the environment [5].

In A. Martin's studies, digital literacy is defined as “awareness, attitude and ability to properly use digital tools and means for working with digital resources, constructing new knowledge, creating media messages and communicating with others in the context of specific life situations ...” [6].

Analysis of the works of domestic authors devoted to the discussion of digital literacy as a concept (Berman N.D., Gaisina S.V., Lisenkova A.A., Potupchik E.G., Rozina I.N., etc.) allow us to speak of ambiguity interpretation of the concept of "digital literacy". On the one hand, digital literacy implies the ability of the learner to effectively use the capabilities of modern digital tools in their daily activities and includes the personal, technical and intellectual skills necessary to interact in a digital environment. On the other hand, digital literacy is defined as computer or information literacy, and more generally as ICT competence [7 - 9].

However, many authors propose to distinguish between these concepts. So Berman ND, highlights significant differences between the concepts of "computer literacy" and "digital literacy", under which "a set of knowledge and skills necessary for the safe and effective use of digital technologies and Internet resources." The author identifies three components of digital literacy (digital competence, digital consumption, digital security) and speaks of the interdisciplinary nature of digital literacy [10].

According to S.V. Gaisina “the difference between digital literacy and ICT competence is cybersecurity and security on the Internet, as the ability to assess the reliability of information, as the ability to preserve your personal and personal data, the ability to protect your own and not violate other people's copyright and intellectual rights” [11].

Sharikov A.V. a multicomponent structure of digital literacy is proposed, consisting of four content fields: "technical and technological capabilities, content and communication capabilities, technical and technological threats and socio-psychological threats" [12].

A more specific understanding of digital literacy is presented in the research of G.W. Soldatova, who highlights the socio-humanitarian and technical and technological components of digital literacy [13].

In the works of L.G. Gavrilova, digital literacy means the effective use of electronic tools, the formation of skills for working with digital information. The author expresses the opinion that digital literacy is the main component of ICT competence ”[14].

Considering the development of the basic competencies of the student, A.A. Lisenkova. defines digital literacy as “the ability to work with large information flows and the development of critical thinking, but also the ability to operate with semantic systems, interpret, evaluate and determine the reliability and quality of information received from the outside” [9].

As a result, it should be noted that despite different approaches to the definition of the concept of digital literacy, the authors understand it as the student's ability to effectively use all the functionalities of modern digital tools. In our opinion, under modern digital tools it is necessary to understand the possession of VR / AR technologies.

4. Methodology

In the course of the research the following methods were used: study and theoretical analysis of psychological, pedagogical, methodological literature; generalization of Russian and foreign experience in the formation of digital literacy of students by means of virtual and augmented reality technologies; observational, experimental, praximetric methods.

4.1. Experimental research base

The experimental base of the research is the Federal State Autonomous Educational Institution of Higher Education "North Caucasus Federal University".

5. Results

A project is being implemented at NCFU - Basic Schools of the Russian Academy of Sciences. This is a new strategic direction of modern education, which is being implemented in accordance with the instruction of the President of the Russian Federation dated December 28, 2018 No. Pr-2543.

Through the system of basic schools of the Russian Academy of Sciences, the task of training personnel and creating "points of growth" for the formation of skills in scientific and project activities, communities of professionals capable of and aimed at solving practical, educational and scientific problems, supporting students with demonstrated abilities is carried out.

Directly at the NCFU site, the RAS base school project has been implemented since September 2019. The educational training involved students from two secondary schools in Stavropol, who showed interest in studying VR / AR technologies, in particular, in designing and programming in the Cospaces and Metaverse environments and developing skills in working with augmented and mixed reality.

To implement the project, a technology was developed for organizing teaching schoolchildren the basics of designing and creating VR / AR applications, which consisted of the following stages:

1. Theoretical.
2. Practical.
3. Design and technological.

To implement the theoretical and practical stages, a training course "Virtual and Augmented Reality" was developed and implemented.

The purpose of the course: the formation of interest in technical types of creativity and engineering areas of training, the development of constructive thinking by means of virtual and augmented reality.

Course objectives:

- to form an understanding of the basic concepts of virtual, augmented and mixed reality, the relevance and prospects of these technologies;
- to form ideas about VR / AR-devices: their design features, the principle of functioning, etc .;
- to form and develop the ability to work with special software (augmented reality tools, graphic 3D editors),
- develop programming skills in the Cospaces and Metaverse environments.
- develop logical thinking and spatial imagination.
- develop the ability to generate ideas for the use of virtual / augmented reality technologies in

solving specific problems.

• develop communicative competencies: the ability to work together in a team, small group (in pairs), participate in a conversation, discussion;

• to form and develop digital competence: the ability to work with various sources of information, independently search, extract and select information necessary for solving educational problems.

As a result of mastering the course, the student acquires:

Knowledge: basic concepts of virtual and augmented reality, design features and principles of operation of VR / AR devices, interface of Blender programs, development of 3D Unity applications, basics of working with platforms for creating VR / AR content Cospaces and Metaverse.

Ability: apply the knowledge gained in the design of VR systems, import 3D models into the VR / AR development environment, develop and debug effective algorithms for creating virtual and augmented reality applications, choose development tools and create virtual and augmented reality applications.

Skills: developing VR / AR systems, creating applications with immersive content using design tools, developing technical documentation for information systems with immersive content.

The theoretical section included in the course content is represented by the following topics:

Topic 1. Fundamentals of virtual and augmented reality technologies.

Topic 2. Basic concepts and definitions of virtual and augmented reality technologies. Applications and environments with immersive content, their functionality. The main areas of application and use of VR / AR technologies.

Topic 3. Review and classification of visualization and interaction equipment for immersive environments

Topic 4. Design and functionality of virtual objects visualization devices: augmented reality glasses, VR helmets, panels and monitors for displaying virtual objects.

Topic 5. Development of virtual reality applications. Software for the functioning of the hardware component of interaction with virtual reality objects. The basics of working with the Unity 3D SDK. Sensors, manipulators, gesture recognition devices.

Topic 6. Development of augmented reality applications. Pattern recognition: methods and types of tasks. Technologies used in augmented reality. Augmented reality application architecture. Applications of augmented reality. Limitations of augmented reality technology

Topic 7. Development of highly efficient virtual and augmented reality applications. Difference between AR, Virtual Reality (VR) and Mixed Reality. Equipment. Leading VR / AR development companies. Application development platforms

The practical stage of the technology of organizing teaching schoolchildren the basics of designing and creating VR / AR applications is presented in the course content by the following practical works:

Lesson 1. Testing devices and pre-installed applications. Study of the features of sensors and controllers. Designing your own virtual reality helmet.

Lesson 2. Getting to know the user interface and window structure. Practicing orientation skills in 3D space.

Lesson 3. Working with objects in 3D space. Editing the internal structure of objects.

Lesson 4. Tools for AR development Unity3D + Vuforia. Introducing Unity3D

Lesson 5. Creating a new project. Loading markers. Adding resources. Linking objects and images to create a complete AR application. Testing the finished project.

Lesson 6. Working with libraries required for exporting an application. Export settings. Export project to * .ark file.

Lesson 7. Development of ideas and scenarios for applications of different levels of immersion in virtual space.

The design and technological stage of the organization of teaching schoolchildren the basics of designing and creating VR / AR applications involved the implementation of an individual or group project aimed at the students' independent development of a virtual, augmented or mixed reality application.

This stage combined all types of students' activities: from the birth of a creative idea to its implementation in the form of a real result associated with the implementation of the plan and aimed at achieving certain goals. This contributed to an increase in the cognitive activity and motivation of

students, the formation of interest in the technologies studied, the development of the creative and research abilities of students.

The projects were implemented in two directions:

• development of a VR application for virtual reality glasses;

• creation of AR-application for devices running Android OS.

When implementing AR and VR projects, students have the opportunity to immerse themselves in an immersive environment, operate with virtual objects, interact with their peers in a team, which allows them to improve their skills in using digital technologies, develop the ability to solve problem problems, and think critically.

Students' design work was carried out using modern platforms. One of them is the online platform CoSpaces Edu, which is used to develop mixed reality web applications and allows users to create and interact with interactive media content. CoSpaces provides students with the opportunity to create virtual interactive worlds to solve educational problems and demonstrate their knowledge in a variety of subject areas, ranging from engineering to humanitarian.

For example, on the CoSpaces platform, the students implemented a project related to the study of English. The project involved the creation of project teams, united through the capabilities of CoSpaces using the "Collaboration" function. Each project participant had the opportunity to work together to create their own space or interactive story, adding static and dynamic objects, animation, sound and other multimedia elements. In addition, by writing code in Blockly, JavaScript, or TypeScript, students can "animate" objects in the virtual world, program objects by developing various reactions to actions, effects, and physical properties of objects.

You just need to drag and drop objects from the library to create a simple virtual world. Another example of the implementation of a project on the CoSpaces platform was a project to create a virtual museum or art gallery. In this project, students, using editable primitive forms, created some kind of virtual space. To give this space a reality, primitives were painted with different colors, textures were applied, they were placed in the form of walls, stairs and even glass cases to demonstrate the exhibits of the virtual museum. Then the finished images and music were loaded into the project.

At the final stage of the project, the trainees created a QR code or link to view and evaluate the project.

In our opinion, the CoSpaces platform is a rather fascinating tool for students to create virtual and three-dimensional worlds, while for teachers it is an effective tool for quickly creating innovative design and research tasks.

Another online platform, Metaverse, which was used to implement projects, allows you to develop mobile applications in augmented reality format, such as mobile games, simple interactive stories, all kinds of educational and business applications.

Metaverse allows you to create immersive interactive content using a variety of pre-built designs, libraries with different characters, GIFs, objects, panoramic images or videos, as well as portals, Google Vision options and much more. The simplest projects that can be implemented on this platform are an interactive quiz, educational game, or just an illustrated story.

Getting started in Metaverse is easy as it has a library that contains a large collection of video tutorials available through the platform's chat function.

The “Amusement Park” project was implemented on the Metaverse platform, in which students, each individually, created a large-scale map of their park or a model of one of the attractions, using the skills and abilities gained as a result of mastering the course “Virtual and Augmented Reality”.

At the stage of presenting the results of the project, using the Metaverse platform, students were shown a self-developed video clip advertising their park. This video contained information about the possibilities and features of the park and was supposed to arouse interest in it.

The project ended with an exhibition in the style of a "science fair" where students presented their amusement park project to guests, parents and educators.

This project showed the perseverance and creativity of the students, their ingenuity. The Metaverse platform has even made it possible to implement “phantom” projects demonstrating the technologies of the future. Some of the projects were close to business projects.

Thus, the design and technological stage of organizing teaching schoolchildren the basics of designing and creating VR / AR applications made it possible to involve students in solving a real problem or finding an answer to a complex question. At this stage, students develop a deep conceptual

understanding of the material, critical thinking and communication skills, the ability to use modern digital tools in practice, the qualities that they will need to succeed in the "real world".

To assess the formation of the level of digital literacy of students in the framework of the basic school of the Russian Academy of Sciences, we will use the method of group expert assessments, in which experts analyze the use of virtual, augmented and mixed reality technologies to increase the level of digital literacy, popularize engineering training, attract young people to the field of science, demonstrate the latest scientific developments and advances in disruptive technology science and technology.

To assess the level of digital literacy and the formation of motivation for the conscious choice of engineering and technical professions, the experts were asked the following questions.

1. Do students have a concept of digitalization of society?
2. What are the knowledge and skills of students in the use of digital tools?
3. Do students have an understanding of the concepts and definitions of virtual and augmented reality?
4. What is the level of knowledge and skills of students in the field of personal computers, classification of visualization and interaction devices for immersive environments?
5. What is the level of knowledge and skills of students in the field of software for the functioning of the hardware component of interaction with virtual reality objects?
6. Do students know how to use specialized software products designed to develop highly effective virtual and augmented reality applications?
7. What is the level of knowledge and skills of students in the development of highly effective virtual and augmented reality applications?
8. Do students know how to use the functionality of modern applications and environments with immersive content in practice?
9. What is the level of productive activity of students in the development of highly effective applications of virtual and augmented reality?
10. Is the level of knowledge and skills of students in the field of application of virtual and augmented reality high?

The processing of expert assessments made it possible to identify a generalized assessment, establish the degree of agreement of experts' opinions and, based on the results obtained, form a decision on the effectiveness of the proposed technology.

Averages are mainly used to determine the generalized assessment of the expert group. Therefore, the calculation of the point estimate for the group of experts was performed as the arithmetic mean for each question Xav.

If several experts participate in the survey, there are discrepancies in their estimates, and the magnitude of these discrepancies is important. If the answers of the individual experts are well consistent, then under this condition the group assessment can be considered sufficiently reliable. The statistical characteristic, the measure of the spread (variation range and standard deviation), was used to establish the degree of agreement of experts' opinions. The variation range R was calculated by the formula:

$$R = X_{max} - X_{min},$$

where X_{min} – the minimum score; X_{max} – the maximum score.

The standard deviation is calculated by the formula:

$$\sigma = \sqrt{\frac{\sum_{j=1}^{m}(x_j - \bar{x})}{m-1}}$$

where xj – assessment given by j-th expert; m - the number of experts.
Indicators for all selected criteria are shown in Table 1.

Table 1
Indicators of the effectiveness of technology for the formation of digital literacy

	1	2	3	4	5	6	7	8	9	10
Xav	4,71	4,79	4,81	4,91	4,66	4,83	4,48	4,97	4,79	4,98
R	0,21	0,25	0,32	0,22	0,12	0,11	0,22	0,13	0,15	0,10
σ	0,022	0,015	0,021	0,013	0,023	0,031	0,023	0,012	0,022	0,011

The experts' assessments and the average value calculated on their basis show that students have a high level of digital literacy and motivation to make a conscious choice of engineering and technical professions.

The values of the variation range and standard deviation for each question, given in Table 1, show the agreed opinion of experts, which allows us to conclude about the effectiveness of the developed technology.

6. Discussion

The concept of digital literacy in the studies of domestic and foreign authors is interpreted ambiguously. The concept of digital literacy proposed by such foreign scientists as M. Varshaver and T. Matuchnyak, P. Gilster, G. Jenkins, A. Martin, E. Hargitai is considered. The conditions for the formation of digital literacy have been identified (G. Jenkins, 2006). The main components of the model of the concept of "digital literacy" are highlighted (D. Belshaw, 2020). The analysis of digital and computer literacy, ICT-competence was carried out by Russian teachers (Berman N.D., Gaisina S.V., Lisenkova A.A., Potupchik E.G., Rozina I.N., etc.). However, there are practically no comprehensive studies devoted to the development of digital literacy of students in the field of using virtual and augmented reality.

7. Conclusion

The rapid development of the digital economy requires constant improvement of digital literacy of the younger generation. In this regard, the issue of creating special conditions for the development of research skills, creative thinking, the ability to solve extraordinary scientific problems in the field of digital technologies is actualized. This problem can be solved by the basic schools of the Russian Academy of Sciences, which act as a means of creating optimal conditions for identifying and working with talented young people, focused on a career in science and high technologies.

The study made it possible to check the effectiveness of the developed technology for the formation of digital literacy of students by means of virtual and augmented reality.

The developed technology can be proposed for the formation of students' interest in technical types of creativity and engineering areas of training, the development of constructive thinking by means of virtual and augmented reality.

8. References

[1] Poddubnaya, N.A., Kulikova, T.A. (2018). AR-technology in the educational process of the university. Vestnik TvGU - Bulletin of TvSU. Series «Pedagogy and Psychology». Issue 4, Tver. 252-256.

[2] Shagrova, G., & Kulikova, T., & Poddubnaya, N., & Ardeev, A. (2019). Innovative approaches to the organization of students» independent learning in accordance with the digital economy requirements. CEUR Workshop Proceedings, International Scientific Conference Innovative

Approaches to the Application of Digital Technologies in Education and Research, Stavropol-Dombay, Russian Federation
[3] Boronenko, T. A., Kaysina, A. V., & Fedotova, V. S. (2019). The development of digital literacy of schoolchildren in conditions of creating a digital educational environment. Perspektivy nauki i obrazovania – Perspectives of Science and Education, 38 (2), 167-193. doi: 10.32744/pse.2019.2.14
[4] Jenkins H., Clinton K., Purushotma R. etc. Confronting the Challenges of Participatory Culture: Media Education for the 21st Century. In: An occasional paper on digital media and learning. The MacArthur Foundation, 2006.
[5] Belshaw D. The Essential elements of digital literacies [Electronic resource]. Available at: http:// digitalliteraci.es (accessed 28 August 2020).
[6] Martin A. & Grudziecki J. DigEuLit: Concepts and tools for digital literacy development // Innovation in Teaching and Learning in Information and Computer Sciences. 2006. Vol. 5(4). P. 249–267, DOI: 10.11120/ ital.2006.05040249.
[7] Potupchik E.G. Network interaction as a condition for the formation of digital literacy of younger schoolchildren in computer science lessons. Bulletin of the Krasnoyarsk State Pedagogical University named after V.P. Astafiev. 2017. vol. 4. no. 42. pp. 178-185. (in Russian).
[8] Rosina I.N. Digital literacy in the course «Academic Writing». Educational technologies and society. 2017. vol. 21. no. 4. pp. 538-556. (in Russian).
[9] Lisenkova A.A. Digital Literacy and Ecology of the Global Network Space. Bulletin of Moscow State University of Culture and Arts. 2017. vol. 5. no. 79. pp. 87-94. (in Russian).
[10] Berman N.D. On the issue of digital literacy. Modern research of social problems. 2017. vol. 8. no. 6-2. pp. 35-38.
[11] Gaysina S.V. Digital literacy and digital educational environment of the school [Electronic resource]. Available at: https://spbappo.ru (accessed 7August 2020) (in Russian).
[12] Sharikov A.V. On the four-component model of digital literacy. Journal of Social Policy Studies. 2016. vol. 14. no. 1. pp. 87-98.
[13] Havrilova L.H. & Topolnik Ya.V. Digital culture, digital literacy, digital competence, and the modern educational environment. Information Technologies and Learning Tools. Theory, Methods and Practice of Using ICT in Educationhttps. 2017. vol. 61, no. 5 [Electronic resource]. Available at: journal.iitta.gov. ua/index.php/itlt/article/view/1744. (accessed 12 August 2020).
[14] Soldatova G.U., Nestik T.A., Rasskazova E.I., Zotova E.Yu. Digital competence of adolescents and parents. The results of the All-Russian study. Moscow, Internet Development Foundation Publ., 2013. 144 p. (in Russian).