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Innovative aspect of modernization of higher education teaching staff

Інноваційний аспект модернізації педагогічного персоналу вищої школи

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Abstract

The article clarifies the essential features of innovation, classification, integral qualities of innovation; factors of innovative learning technologies, and modern innovative learning models. New innovative learning technologies in the modernization of training of specialists in the educational process are defined as distance, blended, and mobile learning. The study's ascertaining stage showed that students' readiness to implement innovative technologies is insufficient, which confirmed the study's relevance in the modernization of professional training of specialists and the role of innovative learning technologies. Based on the generalization

Анотація

У статті з'ясовано сутнісні ознаки інновації, класифікацію, інтегральні якості інновацій, ключові характеристики інноваційних технологій навчання при модернізації професійної підготовки фахівців в освітньому процесі вищої школи. Новими інноваційними технологіями навчання при модернізації професійної підготовки фахівців в освітньому процесі вищої школи визначено дистанційне, змішане та мобільне навчання. Констатувальний етап дослідження показав, що на недостатньому рівні перебуває готовність студентів до впровадження інноваційних технологій, що й підтвердило актуальність дослідження щодо

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of the results of the formative stage of experimental training, it was confirmed that the proposed special course of the specified training is statistically justified and effective, the level of readiness of EG students is higher than that of CG students. Methodological recommendations have been developed for the use of innovative technologies in the modernization of the professional training of specialists and their further application in the professional activities of specialists.

Keywords: innovative learning technologies, modernization of professional training of specialists in higher education, remote laboratories, virtual reality, wireless mobile communication technologies, multimedia information resources.

модернізації професійної підготовки фахівців в освітньому процесі вищої школи та ролі інноваційних технологій навчання. На основі узагальнення результатів формувального етапу експериментального навчання підтверджено, що запропонований спецкурс означеної підготовки є статистично обґрунтованим і ефективним, рівень готовності студентів ЕГ вищий, чим у студентів КГ. Розроблено методичні рекомендації до застосування інноваційних технологій навчання при модернізації професійної підготовки фахівців та подальшому їх застосуванні у фаховій діяльності спеціалістів.

Ключові слова: інноваційні технології навчання, модернізація професійної підготовки фахівців у вищій школі, віддалені лабораторії, віртуальна реальність, бездротові мобільні комунікаційні технології, мультимедійні інформаційні ресурси.

Introduction

The key tasks of education in the 21st century are the development of scientific and innovative activity, and the formation of a personality's thinking focused on creativity and innovation.

In the context of an innovative strategy of a holistic pedagogical process, the role of the management of a higher educational institution, teachers, and methodologists as direct carriers of innovative approaches is significantly increasing. With all the variety of learning technologies: didactic, computer, problem-based, modular-developmental, credit-modular, and others, the implementation of leading pedagogical functions remain with the teacher. The teacher-innovator is the carrier of specific innovations, their creator, and modifier. He has broad opportunities and an unlimited field of activity since in practice he is convinced of the effectiveness of existing technologies and teaching methods and can correct them, conduct research, and develop new methods and technologies. The main condition for such an activity is the innovative potential of the teacher.

With the introduction of modern technologies into the educational process, the teacher increasingly acquires the functions of a consultant, advisor, and mentor. The latter requires special psychological and pedagogical training from him, since in the professional activity of the teacher not only special subject knowledge is implemented, but also modern knowledge in the field of pedagogy and psychology, acmeology, the technology of teaching, and upbringing. On this basis, readiness for the perception, evaluation, and implementation of pedagogical innovations is formed (Dubaseniuk, 2009).

The need for an innovative orientation of pedagogical activity at the present stage of development of education and society as a whole is due to several circumstances.

Firstly, socio-economic transformations and scientific and technical processes determine the need for a radical renewal of the system of higher education, methodology, and technology of organizing the educational process in higher educational institutions. The innovative orientation of the activities of teachers and students involves the creation, development, and use of pedagogical innovations, and acts as a means of updating educational policy.

Secondly, the strengthening of the humanization of the content of education, continuous changes in the volume, and composition of academic disciplines, and the introduction of new specialties, new subjects, and elective courses require a constant search for new organizational forms and teaching technologies. In this regard, the role and importance of the teacher as a generator of pedagogical ideas is growing.

Thirdly, the change in the attitude of teachers to the very fact of mastering and application of pedagogical innovations. The innovative activity was mainly reduced to the use of innovations recommended above. Now innovative activity is becoming increasingly selective and research character. The degree of freedom of the teacher, who previously operated in strictly regulated conditions, is increasing.

Fourthly, the entry of universities into market relations, and the emergence of new types of non-state educational institutions of various forms of ownership, creates a real situation of their competitiveness (Rebukha, 2022).

At the same time, there is a spontaneity in the processes of creating and implementing innovations, the lack of a clear target orientation of innovations, the inconsistency of innovative searches carried out in the theory and practice of educational activities in higher education, the inconsistency of individual innovations with each other, the weakness of developing an innovative strategy for the development of higher education.

Regarding the areas of application of innovations, the majority of teachers (53%) believe that e-learning is advisable to use when studying almost any subject. The opinions of teachers who believe that students lack computer (29%) and communication (21%) skills are almost equally divided. Therefore, we consider it appropriate to consider the Innovative Aspect of Modernizing the Teaching Staff of Higher Education (Shuliak et al., 2022).

The development of innovative technologies in the high-quality training of future specialists is currently a relevant issue of the theory and methodology of teaching in the educational process. Based on this, we considered the following issues in the article: essential features of innovation, integral qualities, classification of innovations, and key characteristics of innovative teaching technologies in the modernization of professional training of specialists; factors of innovative learning technologies and modern innovative learning models; new innovative learning technologies for the modernization of professional training of specialists in the educational process of higher education – distance, blended, and mobile learning.

Literature Review

The scientific literature actively and fruitfully examines the problems of creating and using innovations in higher education, analyzes the conditions for their effective functioning, and develops methods for teaching teachers and students to design innovative pedagogical technologies. The widespread introduction of innovative teaching technologies in higher education has led to the emergence of several scientific studies devoted to this topic.

Theoretical analysis of the problem indicates a wide range of scientific explorations, the results of which serve as a basis for further research. The conceptual foundations of innovative educational processes are considered in the socio-philosophical context of civilizational changes, substantiation of a new paradigm of education, and search for ways to overcome its crisis state. The analysis of the articles of scientists shows that O. Kokhan, O. Magden, & N. Mykhailova (2024) innovative technologies and modern information methods and emphasized the importance of individualized learning programs for effective communication between teachers and students in the educational space, which should be used in the educational process. L. Kotendzhy, I. Deka, & S. Boichenko (2023) considered in the article the professional training of future physical education specialists was linked with the modernization of the entire education system using innovative technologies, showed the importance of ensuring social adaptation to the constant changing living conditions of education seekers, identified the task of targeted development of a specialist, involving him in active ways of mastering cultural experience and social experience, proved the importance of using modern technologies and interactive teaching methods during the modernization of the training of physical education specialists, gave examples of innovative models that contribute to improving the quality of specialist training.

Scientists attach special importance to design in the organization of innovative educational processes as an integral method of cognitive, research, and design activities, the main way of combining pedagogical theory and practice. The features of training specialists are considered in the article by I. Pidlypniak (2022). To improve the pedagogical tools and form the content of professional training of specialists, the possibilities of training educators to use innovative technologies are analyzed. The directions for improving the content of training a future teacher to implement modern technologies in the workplace are outlined. He lights up

the features of implementing innovations; modern trends in training future specialists for pedagogical innovation in practice and theory are identified; the requirements for teachers in the context of implementing educational innovations are outlined, the leading role of new technologies in professional training is proven, and the feasibility of their use by future specialists is shown.

Researchers of socio-cultural and socio-psychological aspects of innovations focus on the analysis of personal characteristics of subjects of innovative activity, the peculiarities of the perception and dissemination of innovations, and the formation of an innovative thinking style. Kh. Bakhtiyarov, A. Aristov & S. Volobuyev (2017) justify the features of the technological approach to education; highlighted in the light of modern concepts of pedagogical theory and practice; creative technologies of learning and teaching are considered. The great importance of the role of innovations in the modernization of professional training of specialists is attached by scientists in monographs and manuals. Thus, L. Rebukha (2022), in the monograph, revealed the methodological principles of innovative learning technologies, showed the development of educational technologies and their theoretical aspects, and considered foreign experience in the development of innovations. In the conditions of digitalization, the authors of the monograph showed the theoretical and methodological practicalities of designing the educational process. An analysis of innovative learning technologies in the education system was made (interactive learning technologies, technologies for forming a creative personality, technologies for a personally oriented educational process, media technologies, and distance learning technologies).

Numerous studies are devoted to the formation of future teachers' readiness for innovative activity during their studies at higher pedagogical educational institutions, as well as the development of innovative competence of teachers 3 in the conditions of postgraduate pedagogical education and in the process of professional, methodological, and self-educational activities. O. Maksymova & M. Fedorova (2022) presented scientific works in the collection that highlight research on the topic of introducing innovations in the modernization of professional training of specialists in the educational process, which cover technologies for implementing an environmental approach in the educational process, the main aspects of education: innovations in methodological support and quality management of the educational process, practice and methodology for implementing modern concepts, student development programs, innovative models and practices of education, training future specialists for innovative activities.

It should be noted that foreign researchers prefer to develop practical aspects of innovation processes.

Research by scientists: C. Ricardo-Barreto, D. Jabba Molinares, H. Llinás, etc. (2020) aimed at recognizing and analyzing the trends of ICT use (hardware, software, and digital educational resources) by higher education professors in the Antioquia region (Colombia), and characterizing this population according to their context. A. Manciaracina (2020) investigates the opportunities offered by an instructional tool, built to help teachers in the creation of hybrid teaching activities in post-pandemic learning contexts. Teachers will design new hybrid contexts by connecting physical space, digital space, innovative pedagogical approaches, and user needs. The starting points are the technical skills acquired by teachers during the period of forced distance learning, the new role of directors and designers of teaching activities assumed by teachers in active learning approaches, and the need for new innovative learning environments able to relate the human and technological components.

Research by O. Pons-Valladares, S. Hosseini & J. Franquesa (2022) is based on developing a new approach that combines several methods (strengths, weaknesses, opportunities, and threats (SWOT); multi-criteria decision-making; Delphi; and the Knapsack problem) and draws from teachers' experience, a panel of experts' expertise, the revised Bloom Taxonomy and neuroscience for education.

However, despite the presence of diverse scientific achievements on the issues of training social workers in the educational environment of a higher education institution, we must state that the theoretical and methodological principles of training social workers in the innovative educational environment of a university have not yet been the subject of special scientific research.

The methodology and concept of training future social workers in the conditions of the innovative educational environment of a university need to be substantiated. The issues of modeling the comprehensive scientific and methodological support for training social workers for professional activity have not been sufficiently studied. In addition, in the practice of training social workers, the resource capabilities of classroom and extracurricular educational and social and educational activities are not fully used.

Analysis of scientific sources, the current state of training specialists for innovative activities indicates the presence of contradictions between:

- Public demand for solving the problem of training specialists capable of implementing innovations in the provision of social services to the population, and insufficient development of the theoretical and methodological foundations of this problem;
- The expediency of creating an innovative educational environment in higher education institutions in the context of training future social workers and the lack of comprehensive scientific and methodological support for this process;
- The need to update the potential opportunities of the university's educational environment and the lack of involvement of teachers in innovative activities;
- The growing role of stakeholders and social partners of the university and the low effectiveness of cooperation with them on the part of the academic community of universities.

The objective need to solve the specified problem, its insufficient theoretical and practical development, and the need to overcome the specified contradictions determined the choice of the topic of the article.

Research purpose: to prove the invaluable role of innovative learning technologies in the modernization of professional training of specialists in the educational process of higher education and to suggest ways to increase the readiness of future specialists to apply and design innovative learning technologies in professional activities.

Methodology

Within the framework of the presented general understanding of the methodology and its highlighted structural components, revealing the essence of the methodology of activity in the pedagogical sphere, we note that important components of the system of methodological knowledge are: a set of principles of pedagogical activity and methods of pedagogical activity, which gives rise to the emergence of teaching methods, research methods, diagnostic methods, methods of managing a certain process, methods of using innovative technologies.

To realize the goal of the study, the next mutually conditioned *research methods* were used: theoretical – study, organization, comparison of scientists' views on the theoretical and practical aspects of the problem under study, and examination of psychological and pedagogical, scientific, philosophical works to determine the subject of the study, the purpose of the study and the classification of technologies; empirical – observations, questionnaires to diagnose the level of readiness of specialists to implement innovative technologies in specialized activities during the modernization of professional training of specialists, qualitative and quantitative analysis of empirical data; methods of mathematical statistics – to verify the reliability of the results of the experiment, evaluate empirical data.

When determining the sample of subjects, the general specificity of the research subject was taken into account. The total sample size was 110 people at the ascertaining stage of the study and 130 people at the formative stage of the study: the control group (CG) – 60 respondents, the experimental group (EG) – 70 respondents, as well as higher education teachers (40 respondents). When forming the sample, the criteria of content, representativeness, and equivalence were taken into account. The sample was formed by random selection using the technical procedure of calculating the selection step.

The reliability and validity of the obtained results, and the objectivity of their assessment were ensured by the methodological soundness of the initial positions and the qualimetric mechanism for assessing the quality under study, the use of a complex of complementary research methods, and the involvement of a group of respondents from a higher educational institution in the analysis of its results.

To assess the homogeneity of experimental and control data collection, statistical processing was carried out using MS Excel and SPSS (Statistical Package for Social Science) programs.

In the study, we used quantitative methods to study a large group of people and subsequently analyzed the data obtained using statistical methods.

We showed a pilot survey of teachers of higher education organizations to control their state of readiness for the design and use of innovative education technologies in the modernization of training of specialists in educational development.

According to the results, it was found that teachers consider it necessary to use innovative education skills in the modernization of professional training of specialists to increase the efficiency of learning. There are 99% of such teachers.

The main obstacle to the request for innovative education technologies in the modernization of professional training of specialists in higher education by teachers was identified.

The task of the ascertaining stage was to study the current state of readiness of future specialists to apply and design innovative learning technologies in professional activities.

The readiness of future specialists to apply and design innovative learning technologies in professional actions is a dynamic component that is subject to diagnosis at different stages of university training. Therefore, three levels have been established: high – constructive, sufficient – reproductive, and low – initial. By the readiness structure, the criteria for determining levels and indicators are substantiated: motivational, cognitive, activity, and evaluation, which ensure the consistent formation of a systematic and holistic understanding of students about the feasibility and relevance of professional, innovative activity in the workplace.

According to the traditional methodology of modern universities, the overall indicator of the success of professional training of specialists in the didactic process for the specified activity was in the range from 1.97 to 1.96, which proves its low effectiveness (training is considered effective if $k \geq 2.7$). Thus, the ascertaining stage of the study showed that the readiness of students to implement innovative technologies is at an insufficient level, which confirmed the importance of the training on the innovation of professional training of specialists in the educational process and the role of innovative learning technologies.

The study included several stages:

In the first preparatory stage, the logic of the proposed structuring of the activities of the experimental groups provided for the intensification of students' independent, innovative search adjustment of the content of professional disciplines from the cycle of practical and professional training of students with topics of an innovative direction.

In the second – practical stage – the training of the special course “The Role of Innovative Teaching Technologies in the Modernization of Professional Training of Specialists in the Educational Process of Higher Education” was introduced into the process of training specialists. New innovative teaching technologies in the modernization of professional specialists training were introduced into the educational process of the EG.

At the third – experimental stage – the EG supplemented innovative material for pedagogical practice for students, where the list of tasks contributed to ensuring an increase in the level of readiness of pupils to practice advanced technologies. At this stage, after completing the formative stage of the study, the success of the introduced new innovative teaching technologies in the modernization of professional training of specialists was substantiated by comparing the results in the control and experimental groups.

To identify differences between the two groups – EG and CG, a comparison of the results of the survey of respondents was conducted. The results of the formative stage of the analysis of the obtained student results indicate that significant positive changes were experienced by the indicators according to all criteria – in EG respondents at the end of the experiment, we observed a significant increase in the indicators of the level of readiness of EG students to apply innovative teaching technologies in the modernization of professional training of specialists in the educational process of higher education:

These differences at the level of statistical significance are manifested in the level of preparation for the application of innovative teaching technologies in the modernization of professional training of specialists in the educational process of higher education based on the proposed special course "The role of innovative

teaching technologies in the modernization of professional training of specialists in the educational process of higher education" and the developed methodology.

A check (Kolmogorov-Smirnov criterion) was carried out for the equivalence of the samples using the data obtained. It should be noted that the two empirical distributions did not differ ($\lambda emp=0.16 < \lambda cr=1.36$) at the beginning of the formative stage, which allowed conducting a pedagogical experiment with selected students.

Based on the generalization of the results of experimental training, we note that a comparative analysis of students' responses within the framework of their professional training at the university indicated the dynamics of students' readiness levels for the application of innovative teaching technologies in the modernization of professional training of specialists and further professional activity.

The dynamic growth of the number of EG respondents who showed a high percentage of mastering the methodology of applying innovative technologies at a sufficient and high level indicates that the proposed special course of the specified training is statistically justified and effective, which was found out using the $\chi 2$ – Pearson criterion: for all components (at $p \leq 0.01$) the level of readiness of EG students is higher than that of CG students.

Grounded on the consequences of the generalization and analysis of the results of the experimental work, we conclude that the level of preparation for the application of innovative teaching technologies in the modernization of professional training of specialists in the educational process of higher education based on a special course ensures the achievement of expected results, which is important in the further professional activity of specialists. Therefore, we have developed methodological recommendations for the application of innovative teaching technologies in the modernization of professional training of specialists and their further application in the specialized activity of experts.

Results and Discussion

1. **Essential features of innovation, integral qualities, classification of innovations, and key characteristics of innovative teaching technologies in the modernization of professional training of specialists.**

Innovations in education are a natural, dynamic, developing, and significant phenomenon in nature and results.

The ability to swell the innovative ground of the didactic situation in an educational institution and effect the general level of specialized action of a future professional is an essential feature of innovation.

Innovation, as a general modern education, is considered by essential abilities: advanced activity, innovative development, innovative atmosphere, and innovative probability. So, innovations in education are the dissemination and introduction of new tools, ideas, managerial and pedagogical technologies into educational practice, the process of creating something new in education, as a result of which the education system transitions to a qualitatively different state, the levels of successes of the organizational mechanisms of education growth (Leleka et al., 2022).

Innovations are classified by the thing of effect (organizational and managerial, pedagogical, socio-psychological), by level of distribution (local-technological, systemic-methodological), and by the innovative potential of the new (combinatorial, modification, radical).

Innovative learning technologies that are improved to the new socio-cultural atmosphere when modernizing the professional training of specialists are aimed at improving the organization of education, content, forms, and methods of the educational process. Innovative learning technologies have a dual focus: they provide for changes in the system of pedagogical training of specialists; they are a necessity income into reason for the deviations taking place in higher education (Dubaseniuk, 2009).

The key characteristics of innovative learning technologies are:

- *Systematicity* – has such features of a system as integrity, process logic, and the interconnection of all elements of the educational process;
- *Conceptuality* – each innovative learning technology is based on a certain scientific concept;
- *Efficiency* – is cost-effective, effective in terms of results, and guarantees the achievement of high-quality learning outcomes;
- *Manageability* – provides for the possibility of planning, goal-setting, designing the educational process, and varying methods and tools to correct the results of phased diagnostics;
- *Adjustability* – provides for the correction of errors, solving set tasks, creatively searching for optimal ways, and preparing for the further application of technologies;
- *Reproducibility* of innovative learning technology by other teachers in other higher educational institutions (Drozich et al., 2023).

Thus, modern pedagogical innovative learning technology is a synthesis of the combination of traditional elements of the experience of mankind, achievements of practice, and pedagogical science and innovations generated by the processes of humanization, social progress, and democratization of society.

2. Factors of innovative learning technologies and modern innovative learning models.

The factors of innovative technologies of education in higher education are:

- New pedagogical thinking of students, social transformations;
- Scientific-pedagogical, psychological approach to education, social sciences;
- Advanced pedagogical experience;
- The experience of the past, foreign and domestic experience;
- Ethnopedagogy, folk pedagogy.

New innovative technologies of education in the modernization of professional training of specialists in the educational process of higher education not only create favorable conditions for student creativity but also put forward new requirements for the teacher, who must:

- Deeply and innovatively master the subject;
- Diagnose the goals of education, personal development, and upbringing;
- Freely master active methods of problem-based developmental education;
- Holistically predict and determine the structure of the educational process;
- Model the professional activity of the future specialist under the conditions of professional training;
- Organize self-educational and independent work of students to prepare them for seminars, lectures, practical classes, and laboratory classes;
- Create rational visualization – fundamentally new types of visual aids;
- Know and be able to differentiate individual classes, group work using computers, etc.;
- Develop structural and logical schemes and supporting notes for the effective construction of lectures (Balalaieva et al., 2023).

Interactive technology is a modern, innovative learning model that implements a new type of pedagogical communication, which is an innovative educational interaction between students and teachers. With this approach, the educational process is considered an innovatively organized, managed, and joint interaction of students in mastering professional and life competencies, which is characterized by objectivity, motivation, and purposefulness and occurs in various forms. The interaction of students and teachers, primarily students among themselves, is the core of interactive technology. This is learning in interaction and cooperation, co-learning, where both the student and the teacher are active subjects of learning (Shetelya et al., 2023).

Interactive technology fundamentally changes the scheme of relations between participants, most closely corresponds to the personally oriented approach, and provides space in learning for students' self-realization.

Let us highlight the characteristic features of interactive learning technologies:

- Construction of the educational process as a series of interconnected problem situations;
- Cooperation of different levels (teacher-student, teacher-group, student-student, student-group);
- Quick feedback – the student can consult at any moment of learning and see the teacher's reaction;
- Reliance on student experience;
- Mainly group work of students in pairs;
- Openness of learning, lack of a specific solution;
- The main element of learning is dialogue;
- Relaxation and emotional upliftment of members in the didactic process (Bakhtiyarov et al., 2017).

Important areas of implementation of innovative technologies are: the formation of educational and, informational, and subject-oriented environments that ensure the development of resources of communication – television, telephone, satellite communication, computer network, for information argument; provide the opportunity to use hypermedia systems, multimedia electronic textbooks, etc.; contribute to the learning of rules and skills of "navigation" in the information space and the development of distance education; provide digital learning, interactive learning, work in virtual laboratories, etc. (Biletska et al., 2021).

3. **New innovative learning technologies for the modernization of professional training of specialists in the educational process of higher education – distance, blended, and mobile learning.**

Scientific research (Bukhkalo et al., 2023; Hepp et al., 2015; Hurman & Kviatkovska, 2023) proves that in higher education, among the innovative technologies that are successfully applied in the educational process, the following can be distinguished:

- Interactive teaching methods that promote active interaction of students with each other and with the teacher, develop creative abilities and critical thinking (group work, brainstorming, project method);
- Multimedia teaching aids that make the educational process interesting and more visual (personal computers, interactive whiteboards, multimedia projectors) (Kokhan et al., 2024).

Multimedia learning tools provide multimedia information presented in graphic and text form using sound data and video in the form of documents, tests, and questionnaires, which may contain links to other materials stored on another server and the same server. The user of the viewing program, using hyperlinks using the browser, has the opportunity to automatically connect to the source of information he needs on the network and request the document to which the link is made. The browser links to the computer network at the request of the Web server.

Modernity requires receiving higher education remotely thanks to information and educational technologies and communication systems, which is caused by the need to receive education by people with disabilities, to study without separation from production, etc.

Learning always, everywhere, all their lives with pleasure – this is approximately the idea of distance education (Kuzminskyi et al., 2021).

One of the important initiatives in the countries of the European Union is to ensure the information literacy of citizens. To this end, the following priorities of new innovative learning technologies have been introduced in the modernization of professional training of specialists in the educational process of higher education (Knysh et al., 2024):

- E-learning for European youth – the ability to use the Internet, multimedia technologies, and resources to acquire professional knowledge and master new skills and abilities;
- Creation of an innovative eCampus (electronic environment) for interactive communication of students and teachers for collective forms of learning and research;
- An important factor in economic and social progress is education, and education is a guarantee of equal opportunities in society. Therefore, the youth of Europe must have appropriate access to information, skills, and necessary knowledge to work and live fully in the information society;

- The need to provide every person with the opportunity to learn throughout life (lifelong learning) therefore, there is a need for continuous improvement of the professional level of employees;
- European content of the global network (eContent) to support enterprises to create jobs with information support – the introduction of teleworking;
- As part of the eEurope plan, e-learning, which is dedicated to the development of methodologies and tools for lifelong learning (creative approach, adaptability to innovations and technologies, new activities, collective forms of work, establishing intercultural ties with foreign colleagues).

Also, among the important and necessary new innovative learning technologies for the modernization of professional training of specialists are the creation of an educational environment and a future educational environment, the use of innovative learning models that use virtual reality to facilitate access to remote laboratories, new wireless mobile communication technologies for information access, and real-time access to multimedia information resources.

The latest innovative learning technologies for the modernization of professional training of specialists in the educational process of higher education include Bring Your Own Device, flipped classroom, learning, Event-based learning, critical thinking, Scenario-Based Learning, design technologies, case study, etc. (Sharples et al., 2014).

New advanced learning technologies in the modernization of professional training of specialists in the educational process of higher education provide a transition from textbooks to the use of Web 2.0 capabilities.

Electronic education is one of the 15 tools for the development of the information society and contributes to expanding students' access to knowledge, taking into account the possibility of building their own learning route; updating technologies, tools, forms, and methods of teaching disciplines. Electronic learning (mobile, distance, blended) acquires a special role in the light of the idea of continuity of education. Thanks to the capabilities of electronic learning, continuing education programs can reach different target audiences at a convenient time and in a convenient place.

So, we see a colossal impact on the education of the Internet and, as a result, a paradigm shift in terms of advanced education technologies in the modernization of professional training of specialists (Rebukha, 2022).

4. Providing the experiment.

Students were involved in the study and experimental work – 110 people at the ascertaining stage of the study and 130 people at the formative stage of the study: control group (CG) – 60 respondents, experimental group (EG) – 70 respondents, as well as higher education teachers (40 respondents).

We showed a pilot survey of educators of higher education institutions to control their state of readiness for the design and use of advanced teaching skills in the modernization of professional training of specialists in the educational process of higher education.

According to the results, it was found that teachers are required to use innovative teaching technologies in the modernization of professional training of specialists in the educational process to increase the efficiency of teaching. There are 99% of such teachers.

The main obstacle to the application of innovative teaching technologies in the modernization of professional training of specialists in the educational process of higher education by teachers was their own insufficient training in their quality design. Such teachers – 60%).

48% of teachers see a lack of educational and methodological materials on the use and design of innovative learning technologies in the modernization of professional training of specialists in the educational process of higher education.

19% of teachers see problems with access to technical equipment and high-speed Internet.

The task of the assessment stage was to study the current state of readiness of future specialists to apply and design innovative learning technologies in professional activities.

We consider the preparation of future specialists for the application of innovative technologies in professional activities as a structured, systematic, purposeful process of forming practical skills, improving theoretical knowledge and skills, the process of ability to create, select, and implement innovative models of training, professional activity, and personal development and, as a result, readiness to apply innovative technologies in professional activities.

The readiness of future specialists to apply and design innovative technologies of training in professional activity is a dynamic component that is subject to diagnosis at different stages of university training. Therefore, three of its levels have been established: high – constructive, sufficient – reproductive, low – initial. By the structure of readiness, the criteria for determining the levels and indicators are substantiated: motivational, cognitive, activity, and evaluation, which ensure the consistent formation of a systematic and holistic understanding of students about the feasibility and relevance of professional innovation activity in the workplace.

The results of the ascertaining stage of the analysis of the results obtained by students indicate that the highest level of formation of indicators is observed for the motivational criterion in respondents (10% – high level; 60% – sufficient level; 30% – low level) (Fig. 1).

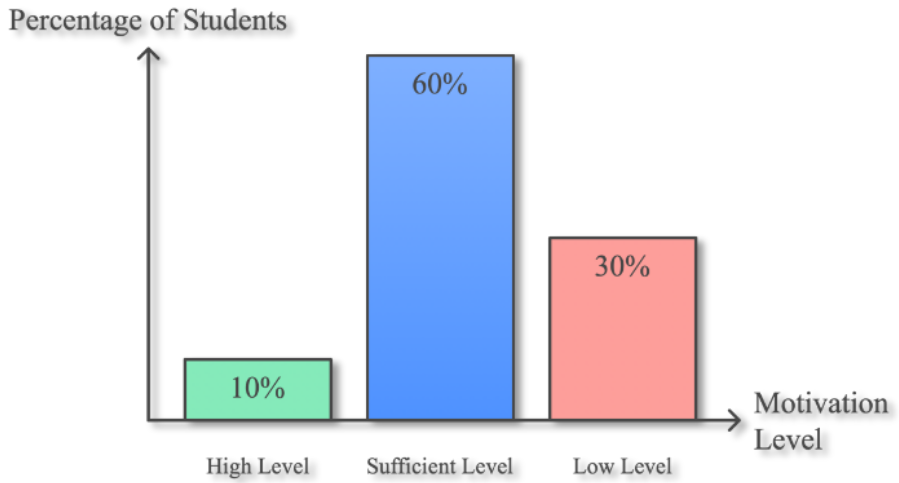

Figure 1. Distribution of Motivational Criterion Levels in Students.

The indicators for the cognitive and activity criteria were mainly at low (60% and 68%, respectively) and sufficient (40% and 32%) levels (Fig. 2).

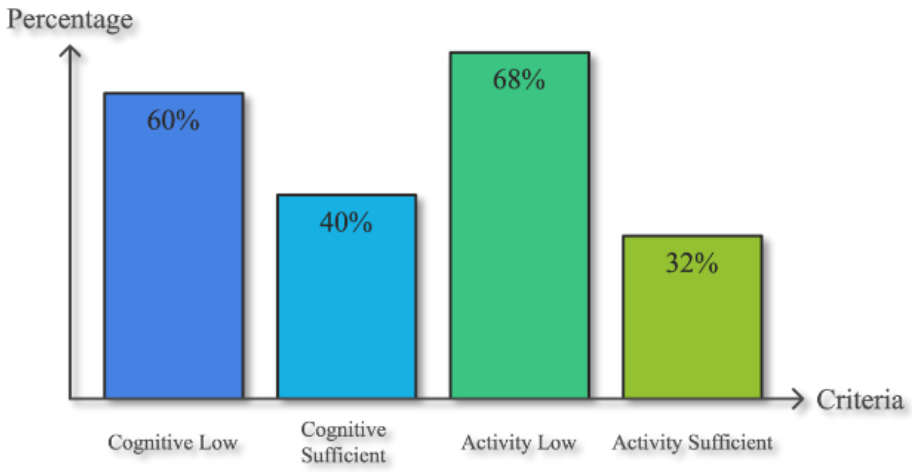

Figure 2. Levels of Cognitive and Activity Criteria.

According to the evaluation criterion, a high level was achieved by 10%, a sufficient level was achieved by 54%, and a low level by 36% of respondents (Fig. 3).

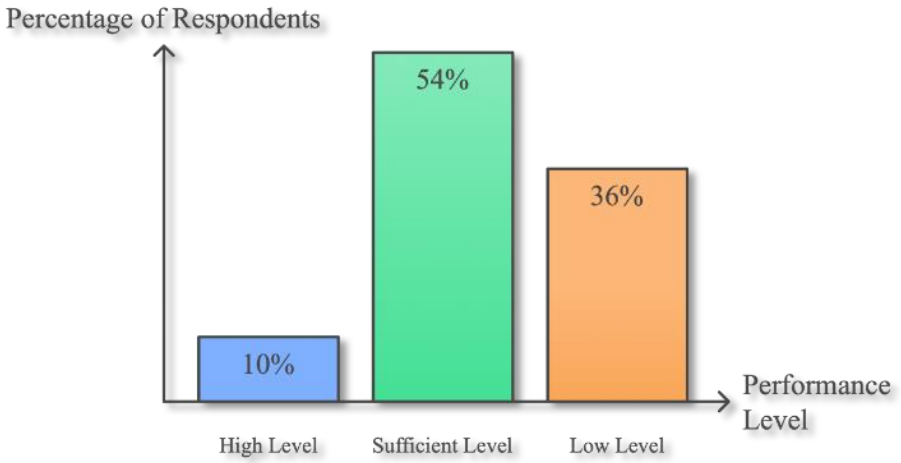

Figure 3. Distribution of Respondent Performance Levels.

According to the traditional methodology of modern universities, the overall indicator of the success of professional training of specialists in the educational process for the specified activity was in the range from 1.97 to 1.96, which proves its low effectiveness (training is considered effective if $k \geq 2.7$).

The ascertaining stage of the study showed that the readiness of students to implement innovative technologies is at an insufficient level, which confirmed the relevance of the study on the modernization of professional training of specialists and the role of innovative learning technologies.

As the core of professional training of specialists in the educational process of higher education and the role of innovative learning technologies, we considered the active activity of students throughout the entire period of study at the university. Its appropriate structuring led to the implementation of the specified goal. The study included several stages.

In the first – preparatory stage, the logic of the proposed structuring of the activities of the experimental groups provided for the activation of innovative independent search of students' adjustment of the content of professional disciplines from the cycle of practical and professional training of students with topics of innovative orientation.

In educational activities, innovative technologies were used (along with traditional ones): interactive lectures; lectures-visualizations, seminars-heuristic conversations, pedagogical training, seminars-discussions, seminars-business games, problem seminars, seminars-conferences, an auction of pedagogical ideas, creative essays, the brainstorming method, which contributed to the developmental impact on the creative and cognitive activity of students.

In the second – practical stage – the study of the special course "The Role of Innovative Learning Technologies in the Modernization of Professional Training of Specialists in the Educational Process of Higher Education" was introduced into the process of training specialists. The content of the special course revealed the essential features of innovation, integral qualities, and classification of innovations; showed the key characteristics of innovative learning technologies in the modernization of professional training of specialists in the educational process of higher education; proposed factors of innovative learning technologies and modern innovative learning models that are implemented in the educational process of higher education; highlighted the characteristic features of interactive learning technologies (Bring Your Own Device, flipped classroom, training, Event-based learning, critical thinking, Scenario-Based Learning, design technologies, casestudy, debriefing, interactive lectures; lectures-visualizations, seminars-heuristic conversations, pedagogical trainings, seminars-discussions, seminars-business games, problem seminars, seminars-conferences, auction of pedagogical ideas, creative essays, brainstorming method, project technologies, case method, web-quest (compilation tasks, Judgment tasks, retelling tasks, persuasion tasks, creative tasks, analytical tasks, self-knowledge tasks, scientist tasks, etc.; virtual learning tools (virtual

classrooms, complex and system simulators, virtual laboratories, situational, procedural simulators, "virtual teacher"; web resources, audio-, (video)-resources, training programs, computer workshops, test task packages, informational text materials with hyperlinks, etc.).

New innovative learning technologies were introduced into the educational process of EG in the modernization of training of specialists in the educational process of higher education – distance, blended, and mobile learning. Also among the important and necessary new innovative learning technologies for the modernization of training of specialists in the educational process was the creation of an educational environment and an environment of the future using innovative learning models (technotainment, tutoring model, the rotational model with the presence of "online stations", rotational model based on laboratories, contextual learning model, interactive learning model, problem-based learning model, student-centered model, flipped learning model, supportive and enriching bilingual learning model, etc.), that use virtual reality to facilitate access to remote laboratories, new wireless mobile communication technologies for information access, multimedia information resources for real-time access.

Taking into account the above, we used innovative approaches in the educational process of higher education. A significant approach is: – immersive learning, which is based on the immersion of students in the educational environment through interactive closed or open simulations. Open simulations include virtual interactive environments (websites, professional video games) where students perform actions related to the profession and communicate with virtual characters. Closed simulations organized in higher education allow students to practice with stakeholders or colleagues. To improve the educational process, modern technologies were used, such as tablets or smartphones, mobile applications, specialized programs, and websites, which allowed students to study at any time convenient for them, from any place. To improve the educational process of the higher school, virtual reality (VR) technologies were used to create interactive simulations where students practiced real situations in a professional space, which allowed students to interact with other virtual characters, feel like a part of reality, hold meetings and conferences in the virtual space, and gatherings to improve knowledge and skills. In particular, VR platforms were used: High Fidelity, EngageVR, Vspatial, Virtual Speech, Bigscreen, Mindshow, Ovation, AltspaceVR, ImmerseMe, Spatial, Venues, Vtime, Beyond VR, ClassVR and others.

We have introduced the latest innovative learning technologies for the modernization of professional training of specialists in the educational process – Bring Your Own Device, flipped classroom, training, Event-based learning, critical thinking, Scenario-Based Learning, design technologies, case study, etc.

The structure of the special course program for EG provides for deepening students' knowledge, familiarization, and communication on various aspects of innovative education: theoretical foundations of innovative activity at the present stage; foreign innovative technologies; the formation and development of the innovative movement in education to the present; features of the innovative activity of a specialist.

EG students compiled a thematic portfolio during the mastering of the special course, which included the results of their independent work. Throughout the entire period of study in higher education, EG students transferred practical skills and abilities acquired knowledge into various types of pedagogical practice.

In the third – experimental stage – EG supplemented students with innovative material for pedagogical practice, where the list of tasks contributed to ensuring an increase in the level of students' readiness to use innovative technologies. At this stage, after completing the formative stage of the study, the effectiveness of the introduced new innovative teaching technologies in the modernization of professional training of specialists was substantiated by comparing the results in the control and experimental groups.

A check (Kolmogorov-Smirnov criterion) was carried out for the equivalence of the samples using the data obtained. It should be noted that the two empirical distributions did not differ ($\lambda emp=0.16 < \lambda cr=1.36$) at the beginning of the formative stage, which allowed conducting a pedagogical experiment with selected students.

Based on the generalization of the results of experimental training, it should be noted that a comparative analysis of students' responses within the framework of their professional training at the university indicated the dynamics of students' readiness levels to apply innovative learning technologies in the modernization of professional training of specialists in the educational process of higher education and further professional activities.

As evidenced by the data obtained from the formative stage of the study, all readiness criteria underwent significant qualitative changes.

The grades of the formative stage of the analysis of the obtained results of students indicate that affording to the motivational principle, at the end of the experiment, we detect a significant rise in the indicator of the level of readiness of EG students to apply innovative learning technologies in the modernization of professional training of specialists:

– 75% of students showed a high level of the pointer (versus 10% before the beginning of the experiment); 25% of respondents showed a sufficient level (versus 60% before the beginning of the experiment); we did not find any students at a low level (versus 30% before the beginning of the experiment) (Fig. 4).

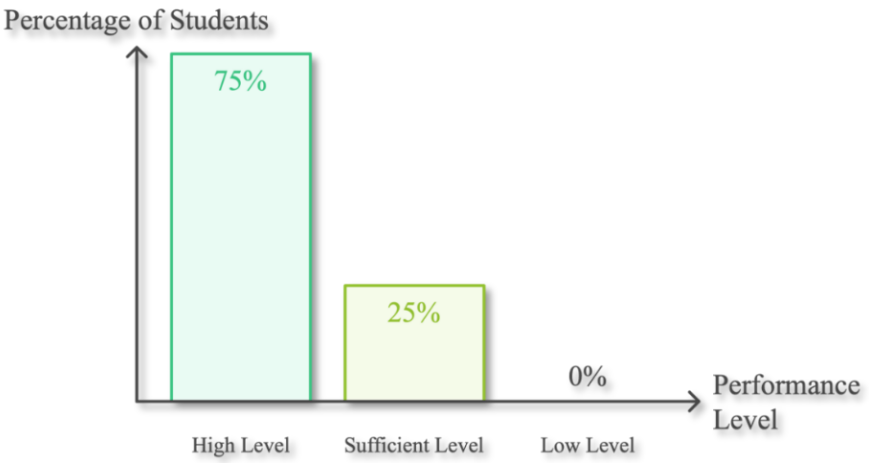

Figure 4. Student Performance Levels After Experiment.

The consequences of the formative stage of the analysis of the obtained results of students indicate that similar changes were observed in the indicators according to the cognitive criterion in respondents at the end of the experiment, with a significant increase in the indicator of the level of readiness of EG students to apply innovative teaching technologies in the modernization of professional training of specialists in the educational process:

– 80% of students reached a high level (before the beginning of the experiment, this indicator was not recorded in the respondents), 20% of students were diagnosed with a sufficient level (versus 40% before the beginning of the experiment); no students with a low level of readiness were identified (versus 60% of students before the beginning of the experiment) (Fig. 5).

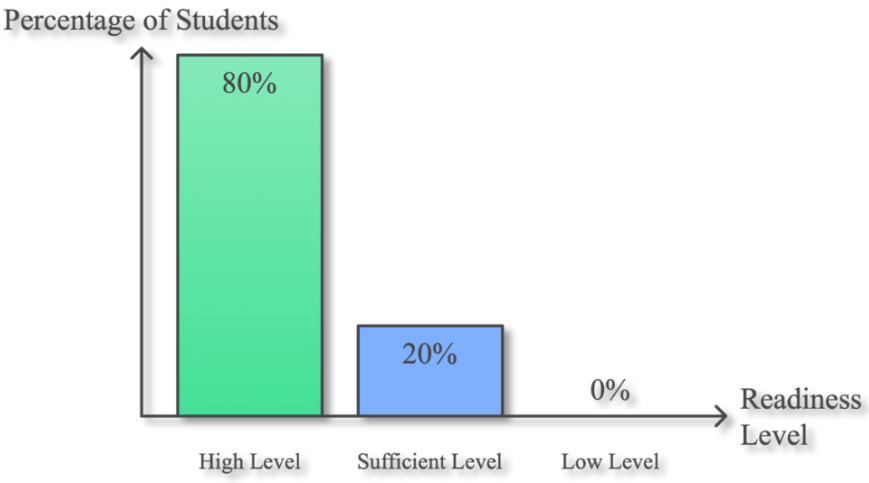

Figure 5. Student Readiness Levels Before and After Experiment.

The outcomes of the formative stage of the analysis of the obtained results of students indicate that similar changes were experienced by the indicators according to the activity criterion – in the EG respondents at the end of the experiment, we detect a significant increase in the indicator of the level of readiness of EG students to apply innovative teaching technologies in the modernization of professional training of specialists: 80% of the students in the experimental group demonstrated a high level (versus zero indicators before the beginning of the experiment); 20% of the respondents showed a sufficient level – (versus 40% before the beginning of the experiment), and the low-level indicators were reduced to zero (versus 68% before the beginning of the experiment) (Fig. 6.).

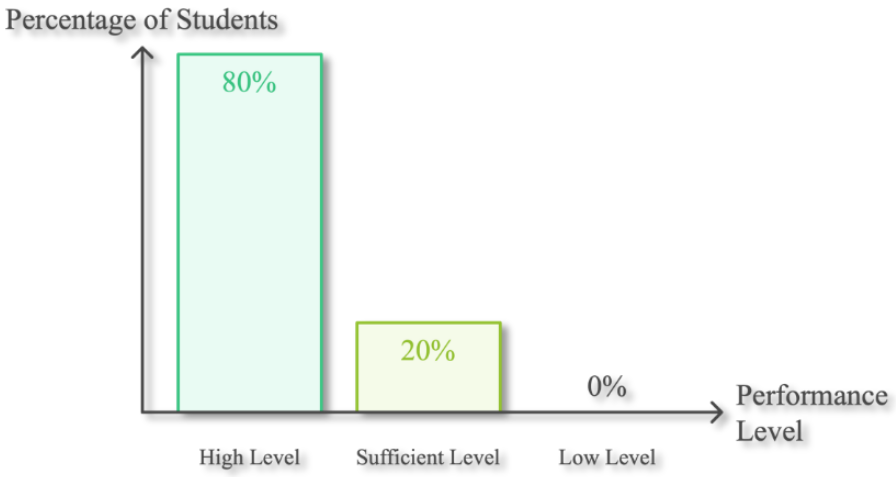

Figure 6. Performance Levels in Experimental Group.

The consequences of the formative stage of the analysis of the obtained results of students indicate that similar changes were experienced by the indicators according to the evaluation criterion – among the EG respondents at the end of the experiment, we detected a significant growth in the indicator of the level of readiness of EG students to apply innovative learning technologies in the modernization of professional training of specialists in the educational process of higher education:

– 68% of respondents reached a high level of development (before the beginning of the experiment – 10%); 32% of respondents reached a sufficient level (before the beginning of the experiment – 54%). The results of the low level are a zero indicator (before the beginning of the experiment – 36% of students) (Fig 7.).

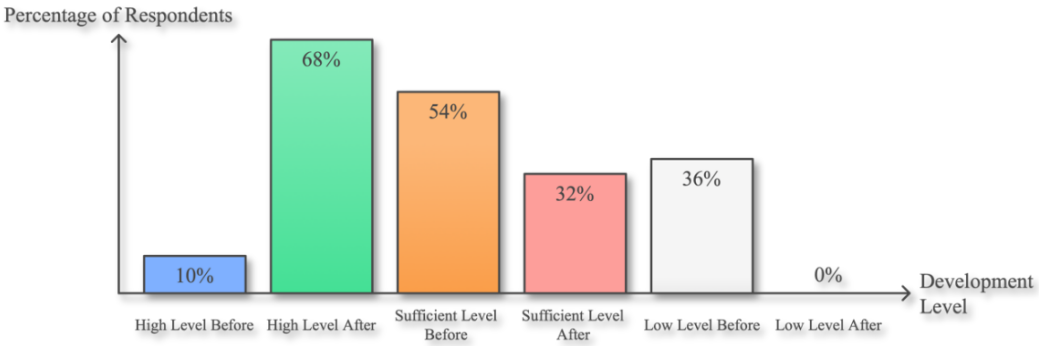

Figure 7. Development Levels Before and After Experiment.

We formulate the null and alternative hypotheses:

Ho: taking into account the arithmetic mean of the scores in the experimental groups and the control groups we say that the methodology for applying innovative technologies in higher education does not affect the educational process of respondents 2 1 x x = 1x 2 x.
H1: the proposed methodology for applying innovative technologies in higher education is effective for the educational process of higher education 1x 2x.

Conducting significance tests showed that the probability value reflects the strength of evidence against the null hypothesis.

When the hypothesis testing procedures were developed, something (if it meant something) was "significant". Thus, we note: finding that the effect is statistically significant means that the effect is not random, but real.

Also, by conducting statistical significance tests, we obtained evidence in support of the alternative hypothesis.

A result was considered statistically significant because it had a p-value below a predetermined threshold (0.05) and had a low probability of occurring by chance. If the p-value falls below this threshold, it means that the observed effect is not a random fluctuation but a true discovery. In statistical tests, the standard deviation is necessary to assess the variability of sample data and is also important for calculating the test statistic and gives an idea of the spread of data points around the mean. For tests such as the t-test, which have mean differences or values in the means, the t-test was calculated. How much the sample mean deviates from the hypothetical population mean in terms of standard error was shown by the t-test, which was calculated using the formula: t = (sample mean – hypothetical mean). Critical values indicate the threshold at a chosen significance level at which results are considered statistically significant. It is statistical significance that determines the level of confidence in the results of a study. A statistically significant result means that the difference or observed effect is not due to chance and gives us additional confidence in our conclusions.

The dynamic growth of the number of respondents of the EG, who showed a high percentage of mastering the methodology of applying innovative technologies at a sufficient and high level, indicates that the proposed special course of the specified training is statistically justified and effective, which was found out using the $\chi 2$ – Pearson criterion: for all components (at $p \leq 0.01$) the level of readiness of EG students is higher than that of CG students.

To identify differences between the two groups – EG and CG, a comparison of the results of the survey of respondents was conducted. The results of the formative stage of the analysis of the obtained student results indicate that significant positive changes were experienced by the indicators according to all criteria – in EG respondents at the end of the experiment, we observed a significant increase in the indicators of the level of readiness of EG students to apply innovative teaching technologies in the modernization of professional training of specialists in the educational process of higher education:

These differences at the level of statistical significance are manifested in the level of preparation for the application of innovative teaching technologies in the modernization of professional training of specialists in the educational process of higher education based on the proposed special course "The role of innovative teaching technologies in the modernization of professional training of specialists in the educational process of higher education" and the developed methodology.

Affording to the consequences of generalization and analysis of the results of experimental work, we conclude that the level of preparation for the application of innovative teaching technologies in the modernization of professional training of specialists based on the special course ensures the achievement of expected results, which is important in the further professional activity of specialists. Therefore, we have developed methodological recommendations for the application of innovative teaching technologies in the modernization of professional training of specialists and their further application in professional activity.

5. Methodological recommendations for the application of innovative teaching technologies in the modernization of professional training of specialists in the educational process of higher education.

Based on the analysis of research results, we offer the following practical recommendations for improving the training of qualified personnel based on modern universities for innovative activities:

– Creation of a blended system of accelerated education, which combines operational online learning and social development technologies based on the use of information from a single knowledge bank of partner organizations;

- Digitization of means of obtaining and mastering knowledge and skills based on the common content of electronic educational resources;
- Embedding modules of fundamental knowledge in learning technology;
- Training and advanced training of specialists in knowledge management based on such techniques of supporting collective decision-making as facilitation, moderation, etc.;
- Comprehensive implementation of the possibilities of implementing a dual form of education as a combination of training in educational institutions with training in the workplace;
- Creation of a new type of educational-scientific-production complex, capable of raising the scientific and technical culture of production, ensuring the development of labor resources.

Research limitations

The implementation of the pedagogical experiment was carried out in three stages during 2022-2024: preparatory, main, and final.

At the preparatory stage, 2022, the goal and objectives of the study were determined, the experimental plan was developed, the methods of measuring and processing the results were determined, the control and experimental groups were selected, and their homogeneity was checked.

At the main stage, 2023, the experiment was conducted.

At the final stage, 2024, the results of the experiment were analyzed, their reliability was confirmed, and conclusions were drawn about the pedagogical effect of the experiment.

Research relies heavily on the accuracy and reliability of data. The following digital data collection tools were useful in the study: MS Excel and SPSS (Statistical Package for Social Science) programs.

The total sample size in the article is 240 respondents. The sample of respondents was formed by random selection using the technical procedure for calculating the selection step.

During the experimental study, diagnostic data on the levels of social competence of higher education applicants were determined through information influence and divided into a control group (60 students) and an experimental group (70 students).

The study was implemented by applying methods and various forms: multimedia technologies (projector, multimedia board, video, and audio equipment), software that combines animation, graphic, text, video, and sound data and information, and their simultaneous use in the information space; mobile devices, personal computer, web-oriented resources that are freely available and free of charge (YouTube, author's website, specialized sites, social networks, cloud technologies, social network technologies), etc.

The limitations of this study allowed it to have the following impact on the results: improving the qualitative characteristics of the material, optimally specified goals and objectives, and increasing the effectiveness of the results.

Future research directions

Further study is required on the issues of organizing the international activities of a modern university, primarily specifying priority areas and current tasks of innovative activities in the context of the internationalization of higher education.

Future research directions can be used to study the effectiveness of combined teaching methods that combine traditional and innovative approaches, as well as the impact of individual learning trajectories on student success. It is worth investigating the use of artificial intelligence to personalize learning, analyzing the long-term consequences of using virtual simulations in natural disciplines and developing approaches to improving social and communicative skills in combination with innovative teaching tools.

Conclusions

The essential features of innovation, classification, integral qualities of innovation, and key characteristics of innovative learning technologies have been clarified: factors of innovative learning technologies and modern innovative learning models.

Our research has introduced important and necessary new innovative learning technologies for the modernization of professional training of specialists: the creation of an educational environment and a future educational environment, the use of innovative learning models that use virtual reality to facilitate access to remote laboratories, new wireless mobile communication technologies for information access, and real-time access to multimedia information resources.

The latest innovative learning technologies for the modernization of professional training of specialists in the educational process of higher education include Bring Your Own Device, flipped classroom, learning, Event-based learning, critical thinking, Scenario-Based Learning, design technologies, case study, etc. New innovative learning technologies in the modernization of professional training of specialists in the educational process provide a transition from textbooks to the use of Web 2.0 capabilities.

Students and teachers of higher education were involved in the research and experimental work. The ascertaining stage of the study showed that the readiness of students to implement innovative technologies is at an insufficient level, which confirmed the relevance of the study on the modernization of professional training of specialists in the educational process of higher education and the role of innovative technologies of education.

The outcomes of the formative stage of the analysis of the obtained results of students indicate that similar changes were experienced by the indicators according to the activity criterion – in the EG respondents at the end of the experiment, we detect a significant increase in the indicator of the level of readiness of EG students to apply innovative teaching technologies in the modernization of professional training of specialists: 80% of the students in the experimental group demonstrated a high level (versus zero indicators before the beginning of the experiment); 20% of the respondents showed a sufficient level – (versus 40% before the beginning of the experiment), and the low-level indicators were reduced to zero (versus 68% before the beginning of the experiment).

Based on the generalization of the results of the formative stage of experimental training, we note that the dynamic growth in the number of EG respondents who showed a high percentage of mastering the methodology of applying innovative technologies at a sufficient and high level indicates that the proposed special course of the specified training is statistically justified and effective, the level of readiness of EG students is higher than that of CG students.

Further research necessitates consideration of the issue of updating the technological content of professional training of future specialists in the background of the integration of higher education into the European educational space.

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