Innovative technologies for the development of critical thinking in students

Інноваційні технології у розвитку критичного мислення студентів

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Abstract

The article reveals the content and level of critical thinking; the key provisions of the philosophy of education, on which the organization of the development of critical thinking of students of higher education should be based, are highlighted; the levels of the process of formation of critical thinking skills and the most important factors and components of the development of critical thinking are considered. The methodological foundations of the research are: leading propositions of the theory of scientific knowledge; general scientific principles of historicism, systematicity, and scientificity; conceptual provisions of pedagogical, psychological, and sociological sciences; ideas of experience based on the simultaneous study of pedagogical, socio-cultural and economic phenomena; philosophical and pedagogical ideas of the development of

Анотація

У статті розкрито змістове та рівневе наповнення критичного мислення; виокремлено ключові положення філософії освіти на які повинна спиратися організація розвитку критичного мислення здобувачів вищої освіти; розглянуто рівні процесу формування навичок критичного мислення й найважливіші чинники та складники розвитку критичного мислення. Методологічними засадами дослідження є: провідні положення теорії наукового пізнання; загальнонаукові принципи історизму, системності, науковості; концептуальні положення педагогічних, психологічних, соціологічних наук; ідеї досвіду на основі синхронного вивчення педагогічних, соціально-культурних і економічних явищ; філософсько-педагогічні ідеї розвитку сучасної освіти. Методологічна

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modern education. The methodological basis of the research is presented on four hierarchically subordinated levels: philosophical, general scientific, specifically scientific, and technological. The diagnostics of the system for improving students' critical thinking and the professional readiness of future specialists allowed us to talk about integrated indicators of the formation of the professional readiness of future specialists and increasing the level of critical thinking of students at the formative stage of the experiment. The increase in students' critical thinking and the formation of professional readiness of future specialists by all indicators is 15%, which is a positive result. Positive changes in the levels of student's critical thinking and the formation of professional readiness of future EG specialists compared to CG were revealed. Increasing the level of this readiness among EG students is due to the introduction of the author's system for improving students' critical thinking with the use of innovative technologies. The conclusion emphasizes that the use of innovative technologies increases the level of critical thinking of students and their professional readiness.

Keywords: innovative technologies, critical thinking, students, professional readiness, pedagogical innovations.

основа дослідження представлена на чотирьох ієрархічно підпорядкованих рівнях: філософському, загальнонауковому, конкретно науковому та технологічному. Проведена діагностика системи підвищення критичного мислення студентів та професійної готовності майбутніх фахівців дозволила говорити про інтегровані показники сформованості професійної готовності майбутніх фахівців та підвищення рівня критичного мислення студентів на формувальному етапі експерименту. Підвищення критичного мислення студентів та сформованості професійної готовності майбутніх спеціалістів за всіма показниками становить 15%, що є позитивним результатом. Виявлено позитивні зміни у рівнях критичного мислення студентів та сформованості професійної готовності майбутніх фахівців ЕГ порівняно з КГ. Підвищення рівня цієї готовності у студентів ЕГ зумовлено впровадженням авторської системи вдосконалення критичного мислення студентів з використанням інноваційних технологій. У висновку наголошено що використання інноваційних технологій підвищує рівень критичного мислення студентів та їх професійної готовності.

Ключові слова: інноваційні технології, критичне мислення, студенти, професійна готовність, педагогічні інновації.

Introduction

The development of scientific and technical progress today has led to the fact that society is gradually entering a new era of development, where the main values are information and knowledge. Global informatization, the rapid increase in the speed of information exchange, and the change in the methods, forms, and purposes of this exchange have caused the emergence of information inequality - the stratification of society according to a new feature: those who use new information and communication realities for their own development, education, simplifying the performance of daily tasks, and those, who falls outside the boundaries of the world process and, due to his own ignorance, becomes an object of influence and manipulation.

The use of modern technologies in education should play a key role in creating the necessary conditions for the self-development of all subjects of educational activity, activating cognitive and creative processes, forming the necessary competencies, and promoting the establishment of humanistic ideas. The global spread of global information and communication networks requires different content and quality of pedagogical education, legitimizes the rapid change of traditional educational models to integrative, dynamic ones that combine humanistic and technological approaches, making it possible to reveal the cognitive and creative potential of future specialists (Liakisheva et al., 2022).

Conducted research in the domestic educational space shows the spontaneous emergence and spread of digital narratives in social networks, the intensive expansion of biographical digital narratives in modern mass media, and the purposeful use of various types of narratives in the advertising industry. At the same time, we note insufficient coverage of the problem of improving the quality of education of future masters of education through the use of various types of digital narratives for the formation of 21st-century competencies, in particular, the development of student's cognitive, creative, communicative and technological skills, which is extremely important in both personal and professional life.

Critical thinking is considered to be a skill of the 21st century because in the digital age, without it, it is impossible to comprehensively analyze real-life situations, to be an effective and modern citizen of the world, and to consider ways of realizing and protecting one's rights in it. Thinking critically, a person can protect and realize their rights because they can reject tampering, ask questions, be honest with themselves, freely follow the connections between phenomena, overcome confusion, make their conclusions based on obvious facts, and are intellectually independent. Undoubtedly, the introduction into the educational process of learning, which is focused on the development of critical thinking and the use of innovative technologies to improve the critical thinking of students, is a methodical urgent problem of the 21st century and the modern educational paradigm. So, the time has come when not natural resources, technology, or capital but the mental abilities of people will determine the decisive line between failure and success, between leaders and subordinates (Terno, 2023).

At the same time, the changing world, external and internal challenges, and the rapidity of social, economic, and political processes in the modern world and Ukraine require citizens capable of critical perception of information, vital self-identification, determination of goals based on universal human values, making responsible decisions, creative solutions life tasks, including professional ones, which requires mastery of critical thinking. The ability of future generations to think critically will determine the vector of the country's development, and the formation of such an ability must begin with the modernization of the system of professional training of specialists.

So, the relevance of insufficient development of the raised problem of innovative technologies in the development of student's critical thinking and the need for their solution at the scientific-theoretical, methodical, and practical levels determined the choice of the topic of the article.

Investigating the problem of innovative technologies in the development of student's critical thinking, we paid attention to the following main aspects:

- Contentful and level filling of critical thinking.
- The most important factors and components of the development of critical thinking.
- Groups and types and systematics of pedagogical innovations to increase the level of critical thinking of students.
- Use of innovative technologies to increase the level of critical thinking of students.
- The problem of innovative technologies in the development of students' critical thinking has been experimentally tested.

The purpose of the study. Increasing the level of critical thinking of students and the professional readiness of future specialists through the use of innovative technologies.

Literature Review

Nowadays, pedagogues and psychologists are actively developing the problem of developing critical thinking in students. Methodological developments are published, dissertations are defended, and scientific articles, monographs, etc. are written.

Thus, the use of technology for the development of critical thinking of higher school graduates was investigated by H. Yurchak (2020) in classes on the discipline "Ukrainian language (for professional orientation)". In particular, the meaning of the concept of "critical thinking" was revealed, the latest scientific research was analyzed in the field of critical thinking development strategies, the main principles and characteristic features of critical thinking were defined, and effective implementation methods were analyzed. The main signs of the developed critical thinking of students are given (the ability to make informed decisions, draw logical conclusions, and evaluate the received information). The significance of the application of effective, innovative techniques, with the aim of a collective search for innovative solutions, which leads to the cooperation of the teacher with students, shows the necessity of using the technology of human critical thinking in institutions of higher education. The main stages of development of critical thinking are analyzed: "comprehension", "challenge", and "consolidation". It has been proven that the development of critical thinking and the use of innovative technologies to increase the critical thinking of students is a multifaceted systematic learning process, the purpose of which is the formation of one's own thinking style, the ability of a person to politely defend and objectively evaluate one's own position, to form a personal independent opinion, to be resistant to the influence of other people's opinions.

To raise the professional level of students by mastering the technology of developing critical thinking, A. Liakisheva, V. Vitiuk, & I. Kashubiak (2022) proposed a manual for future primary school teachers, which provides examples of the application of techniques and methods of developing critical thinking in individual subjects, in particular, during the study of integrated courses in mathematics, linguistics, and natural sciences in primary grades. The proposed casebook can be implemented in the school to provide various forms of integrated learning. The casebook contains a description of the most common techniques and methods of developing critical thinking.

The method of developing critical thinking is disclosed, and the advantages of the theory of critical thinking by S. Terno (2023) are presented. The basis of the methodology for the development of critical thinking is the postulate that critical thinking is reflective, independent, conscious, goal-directed, controlled, self-organized, and grounded thinking. The essential feature of the methodology for the development of critical thinking is singled out – the involvement of students of higher education through the use of problem-based methods and interactive forms of learning to solve problematic problems that involve reflection of cognitive activity and scientific dialogue.

P. Pintrich (2002) emphasizes the responsibility and importance of using new educational technologies for awareness of one's own knowledge and thinking. It has been proven that education traditionally emphasizes actual, conceptual, and procedural learning of higher education students, and it is precisely these types of student knowledge that are evaluated resources, and without metacognitive knowledge, learning is very problematic. If students all increase their thinking about cognition, they will become more developed. According to the scientist, "metacognition consists of two components: knowledge about cognition (knowledge of learning and thinking strategies, knowledge about different types of tasks and cultural norms, self-knowledge – knowledge about oneself); processes of control and regulation of cognition". These components are deployed and interact in parallel.

The theoretical aspects of the development of educational technologies were presented in research by scientists L. Rebukha, I. Bilous, R. Brik, A. Demyaniuk, V. Savytska, O. Krychkivska, & V. Kavetskyi (2022): foreign experience in the development of the latest technologies in the educational field, current trends were considered development of innovative technologies. Innovative learning technologies are characterized in the education system as innovations in the educational process – media learning technologies, interactive and remote learning technologies, technologies of the personally-oriented educational process, and technologies of creative personality formation. Methodological foundations of innovative learning technologies are disclosed. In institutions of higher education in the conditions of digitalization, the theoretical and methodological foundations of the design of the educational process were considered. Special attention is paid to the practical context of the application of innovative educational technologies. In the conditions of modernization of modern education, pedagogical innovations are investigated.

So, scientists revealed the meaning of the concept of "critical thinking", as well as analyzed the latest scientific research in the field of strategies for the development of critical thinking, defined the main principles and characteristic features of critical thinking, and analyzed effective methods of implementation. The main signs of the developed critical thinking of students are given (the ability to make informed decisions, draw logical conclusions, and evaluate the received information). The main stages of the development of critical thinking are analyzed. The method of development of critical thinking is disclosed, and the advantages of the theory of critical thinking are presented. The theoretical aspects of the development of educational technologies are presented in the research of scientists: the foreign experience of the development of the latest technologies in the educational field and the current trends in the development of innovative technologies are considered. Innovative learning technologies are characterized in the education system. Methodological foundations of innovative learning technologies are disclosed, and in the conditions of modernization of modern education, pedagogical innovations were investigated. However, the ways of using innovative technologies to improve students' critical thinking have not been sufficiently revealed.

At the same time, the study of the results of scientific research revealed the insufficiency of scientific research in the direction of the formation of critical thinking of future specialists in the conditions of informatization of education.

In particular, our analysis of the state of development of the problem gave rise to the following contradictions:

– Between the demand of Ukrainian society for specialists with developed critical thinking and established approaches to their professional training, oriented to a greater extent on the acquisition of professional knowledge and skills, insufficient orientation of the educational process in vocational education institutions on the development of future specialists' high-level thinking skills (analysis, synthesis, comparison, comparison, generalization, systematization, etc.);
– Between the development of information technologies, the increase in the weight of informatics disciplines in programs of professional training of specialists, and the lack of effective models for the development of critical thinking of future specialists in the process of their study.

So, the relevance of the problem's theoretical and practical significance determined the choice of the topic of the article.

Methodology

The methodological foundations of the research are: leading propositions of the theory of scientific knowledge; general scientific principles of historicism, systematicity, and scientificity; conceptual provisions of pedagogical, psychological, and sociological sciences; ideas of experience based on the simultaneous study of pedagogical, socio-cultural and economic phenomena; philosophical and pedagogical ideas of the development of modern education.

The methodological basis of the research is presented on four hierarchically subordinated levels: philosophical, general scientific, specifically scientific, and technological.

To solve the set goal, the following research methods were used at various stages of scientific research:

– ***Theoretical*** – scientific synthesis and analysis of psychological and pedagogical, philosophical sources, Internet resources, scientific literature on the research problem; deduction and induction for the formation of conceptual foundations of research; summarizing and studying the practice of higher education; to find out the current state of the identified problem, a comparative analysis of the use of innovative technologies to improve students' critical thinking was carried out; comparison and classification to determine the essential characteristics of innovative technologies to improve students' critical thinking and professional readiness of future specialists;
– ***Empirical*** – (observations, interviews, questionnaires, self-assessment, expert assessment) to diagnose the level of critical thinking of students using innovative technologies and the readiness of future specialists for professional activity; a pedagogical experiment with a qualitative and quantitative analysis of the results to check the effectiveness of the author's system for improving the critical thinking of students and the professional readiness of future specialists;
– ***Methods of mathematical statistics*** for qualitative and quantitative analysis of research results, checking their validity and objectivity.

The program and methodology of research and experimental work to check the effectiveness of the system for raising the level of critical thinking of students using innovative technologies was carried out in several stages with the determination of scientific and pedagogical methods and tasks of research organization.

The first stage is informational, consisting of the formation of student's ideas about the specifics of future professional activity in the conditions of modern society.

The second stage - the technological stage consists of the formation of future specialists' abilities and skills to realize the purpose, functions, and tasks of professional activity in the conditions of education, training, and development in the mastery of general pedagogical, creative technologies to increase the level of critical thinking of students.

The third stage is creative, consisting of the formation of the ability to reflect, mastering the system of increasing the level of critical thinking of students, the experience the professional activity of the future specialist, and improving professional skills and professional activity skills through the introduction of innovative technologies.

For the experiment with higher educational institutions, a representative sample of the number of students was determined. 140 students were involved in the ascertaining stage of the experiment. The control group consisted of 54 people, and the experimental group - 50 respondents from higher educational institutions.

Quantitative methods were used in the study to study a large group of people, and subsequently, the obtained data were analyzed using statistical methods.

The experiment was conducted at Sumy State Pedagogical University named after A. S. Makarenko, Vasyl' Stus Donetsk National University, National Technical University of Ukraine "Ihor Sikorskyi Kyiv Polytechnic Institute". The conduct of the experiment is permitted by the scientific councils of the universities in order not to violate ethical considerations in institutions of higher education.

The program and methodology of research and experimental work to check the effectiveness of the system for improving students' critical thinking using innovative technologies was carried out in several stages with the determination of scientific and pedagogical methods and tasks of the research organization.

After the formative stage of the experiment, we found positive dynamics of increasing the level of critical thinking of students and the professional readiness of future specialists in EG, while in CG, these changes turned out to be practically unchanged.

The conducted diagnostics of the system for increasing students' critical thinking and professional readiness of future specialists allowed us to talk about integrated indicators of the formation of professional readiness of future specialists and increasing students' critical thinking at the formative stage of the experiment.

The increase in critical thinking of students and the formation of professional readiness of future specialists by all indicators is 15%, which is a positive result. With the help of K. Pearson's linear correlation method, the Kolmogorov-Smirnov statistical criterion, and the E. Pustilnyk method, the reliability of the obtained data was checked using the SPSS Statistics 17.0 package to check the compliance of empirical data with the laws of factor analysis and normal distribution.

Consequently, positive changes in the levels of student's critical thinking and the formation of professional readiness of future specialists in EG compared to CG were revealed. The increase in the level of this readiness among EG students is due to the introduction of the author's system for improving students' critical thinking using innovative technologies. According to all indicators, the increase in students' critical thinking using innovative technologies and the formation of future specialists' professional readiness at the experiment's formative stage is 15%, which is a positive result.

Before using survey instruments to collect data and to assess the quality of the collected data, we aimed to ensure in the research process that, we used survey instruments in the experiment that were reliable, accurate, and valid. The reliability, accuracy, and validity of the data were of decisive importance in our study since they guarantee the consistency, accuracy, and reliability of the obtained research results, contribute to the formation of conclusions, and their justification, which is the key to the success of the study.

We considered the measurement tool to be reliable because it consistently gave the same results when we repeated it to measure the same phenomenon.

We considered the measurement tool to be valid because it accurately measured the concepts and gave results that are relevant and significant for proving the effectiveness of the system for improving students' critical thinking using innovative technologies. We assert that reliability and validity have agreed on the measurement, and validity has proven the truthfulness and accuracy of the measurement, ensured the results obtained with the measurement instrument, and proven the significance and relevance of the research question.

With the help of SPSS (Statistical Package for Social Science) and MS Excel programs, statistical processing was performed to assess the reliability, homogeneity, reliability, and validity of experimental and control data.

The assessment of the reliability, homogeneity, reliability, and validity of experimental and control data in the process of developing our research tool to verify the effectiveness of the system of increasing students' critical thinking using innovative technologies such as surveys, questionnaires confirmed between different respondents the consistency, stability of the measurement, and the validity showed the degree, to which the instrument measures what is planned for the experimental study and increases the reliability and quality of the study.

Results and Discussion

Critical Thinking Analysis:

Critical thinking is considered in the modern world as learning the ability to think, as an urgent need for life, which allows any professional activity to correctly solve a wide range of practical problems and is necessary for everyday life, in scientific activity, in human relationships (situations of moral choice), etc. They associate critical thinking with science as a field of research aimed at obtaining knowledge about society, thinking, and nature. Critical thinking is considered a scientific approach to solving a wide range of problems – from professional to everyday problems.

The most important characteristic of scientific thinking is criticality, and the search for contradictions or inconsistencies is criticism. And scientific progress consists in the elimination of contradictions.

In the process of learning, critical thinking has several levels:

1)   *General thinking* – the general process of information processing;
2)   *Subject thinking* (historical, mathematical, etc.) – the process of processing information using methods of scientific research on a certain subject, enriched with methodological and subject knowledge;
3)   *Critical thinking* – the process of monitoring the course of the subject and general thinking their improvement.

Each subsequent level includes the previous one.

Critical thinking consists of certain procedures of factual validity aimed at ensuring the logical perfection and value appropriateness of reasoning from certain attitudes of the researcher, which orient him to the breadth of coverage of factual information, taking into account the context, etc.

Let's consider six levels of the process of formation of critical thinking skills. It is quite complex and lengthy and includes:

1)   Collection of necessary information, that is, the level of discovery of facts;
2)   Level of problem detection;
3)   Creation of conditions for solving the problem, that is, the level of identifying the essence of the problem;
4)   Level of discovery of ideas;
5)   Identification of possible solutions;
6)   To solve the problem situation of drawing up an action plan, that is, the level of detection of support (Knysh et al., 2023).

Critical thinking consists of skills (disclosure of possibilities and alternatives, reasoned judgment, productivity in perception and formation of ideas, etc.), as well as dispositions (attention to the research procedure; conviction of the need for self-correction of the research method; readiness to be self-critical and critical; consideration of other points vision), which constitutes dedication to the research orientation in education and the further life position of a person (Zaitaseva, 2022).

The most important factors and components of the development of critical thinking.

Let's single out the four most important factors in the development of critical thinking:

1)   *Form of education* – in the process of solving choice situations, dialogue is provided;

2) ***The teaching method*** – provides for the systematic creation of choice situations for students in the field of education;

3) ***Method of control and self-control*** – involves the following individual and group reflection and written tasks (criticism and analysis, self-criticism, and self-analysis). According to the effectiveness of educational and cognitive activities, methods of control and self-control include methods of laboratory-practical control and self-control, methods of written control and self-control, and methods of oral control and self-control. Each group is appropriate for teaching critical thinking and has its own advantages;

4) ***The right to make a mistake*** gives the learner a learning style that simulates situations of correcting mistakes because it is the mistake that is a companion in any independent activity, but it is important to learn to correct it and notice it. The teacher and students should not be afraid of a mistake, but there should be a desire to correct and understand it. Correcting one's attitudes and procedures involves self-organization of thinking. Thus, both the teacher and the student in the course of learning should have the right to make a mistake since a mistake is an integral and natural part of learning according to the principle of complementarity (Terno, 2023).

In the modern educational process, one of the important components is the use of innovative and active methods, methods, and learning technologies in classes to improve students' critical thinking. Such classes are the most successful because the student is encouraged to think critically and independently, think about what he is learning, and where he can apply what he has learned in real life or for independent work or further education. Learning becomes effective, effectively uses the teacher's time, saves society's funds, does not give place to passivity, is actively used in practice, and provides an opportunity for personality development (Kuchai & Demianiuk, 2021).

The choice and use of innovative technologies to improve students' critical thinking during education depends on the education system in which the education process takes place. The most optimal are the technologies of a problematic, research, heuristic nature that contribute to the development of critical thinking of the individual, allow students to freely express their opinions, and tolerantly discuss communicate with communicators of different ages and genders since critical thinking is social thinking (Liakisheva et al., 2022).

We consider innovation to be a purposeful, specially organized, controlled, continuous process of accelerated entry of an individual into an independent life process, a process of practical implementation by the subjects of innovative activity of new means of learning, new technologies, organizational and management approaches, ideas that result in a significant increase in the indicators of the development of the individual as a carrier of knowledge, quality of education, relevant competencies (Rebukha et al., 2022). The main goal of innovations in education is "the need to respond to the challenge of globalization transformations, environmental problems, multicultural trends in the world... It is characteristic for our time to establish the priority of innovative development of education based on the modernization of all components of the system (content..., training of pedagogical personnel, management, financing, etc.)" (Prosalova et al., 2022).

So, if innovation is the main form of development in the entire field of education, then innovation management is the main mechanism, which is a process that includes the creation of conditions for the reproduction of innovative education and determines its quality as a whole. Thus, in the conditions of modernization of modern education, innovations, in particular, innovative technologies for increasing the critical thinking of students and their implementation in the practice of the educational process of a higher school, represent a diverse, rather complex pedagogical phenomenon, which assumes systematic and active creativity of the individual (Rebukha et al., 2022).

Groups and types and systematics of pedagogical innovations to increase the level of critical thinking of students.

Let's emphasize important groups of pedagogical innovations that are necessary to improve students' critical thinking (Dychkivska, 2015):

1. *Depending on the scope of application:*

− Innovations in the technology of education and training of the individual for interaction in the educational process and renewal of teaching and learning methods;
− Innovations in the content of education to increase students' critical thinking (updating manuals, textbooks, curriculum content, etc.);
− Innovations in the organization of the pedagogical process (updating the forms and means of the educational process);
− Innovations in education management for innovative organization and management of educational institutions, and renewal of the structure of the educational process.

2. *Depending on the scale of transformations (they involve restructuring the entire institution according to a certain idea, creating a new educational institution based on a previous one, or creating an innovative concept):*

− Partial unrelated (single, local) innovations;
− Modular innovations, a complex of partial innovations, interconnected, belonging to one age group of people, to one group of subjects, etc.;
− Systemic innovations covering the entire educational institution.

3. *Depending on the innovation potential:*

− Modifying innovations to improve students' critical thinking is aimed at the personal aspects of the tool, the technological one that is being updated, related to the rationalization, modification, improvement, and modernization of what has a prototype or analog (program, separate development, methodology, etc.);
− Combinatorial innovations are a constructive combination in which new system properties appear, generating a new effect of innovations that have not yet been used in this version;
− Fundamental, radical, basic, and global innovations, which are discoveries that contribute to the creation of fundamentally new means in education, most often arise as a result of creative integration.

4. *Depending on the position of its predecessor:*

− Substitute innovations that are used instead of a specific outdated tool;
− Canceling innovations, which consists of canceling the form of work in stopping the activities of certain bodies or associations if they inhibit development, is unpromising given the needs of the development of the educational institution;
− Groundbreaking innovations that involve the development of new technology, a new type of educational services, a new program, etc.);
− Retro-introduction – in the institution of higher education, the development of innovations that were used and existed earlier in pedagogical practice was canceled by mistake.

5. *Depending on the place of appearance:*

− The introduction of pedagogical innovations to increase students' critical thinking in science (updating pedagogical theory);
− Innovation in practice, and update of pedagogical practice to improve students' critical thinking.

6. *Depending on the time of appearance:*

− Historical innovations of pedagogical innovations to increase students' critical thinking (revival of historical and pedagogical heritage in new conditions);
− Modern innovations of today's pedagogical innovations to improve student's critical thinking.

7. *Depending on the level of forecasting, planning, and anticipation:*

− Planned expected innovations to improve students' critical thinking;
− Unplanned, unexpected innovations to improve students' critical thinking.

8. *Depending on the field of pedagogical knowledge:*

- Educational, in the field of education, innovations to improve students' critical thinking;
- Didactic, in the field of education, innovations in pedagogical innovations to improve students' critical thinking;
- historical and pedagogical, in the field of history of pedagogy, innovations, etc. (Kharchenko, 2019).

Use of innovative technologies to increase the level of critical thinking of students.

The technology of personally oriented training. The goal of modern education is an independent, creative, free personality, capable of learning the skills, knowledge, skills, and self-development needed in life, and not a person who has simply mastered a set of certain knowledge, skills, and abilities. Such a goal of modern education can be achieved by building our education based on personally oriented education.

"Personally oriented education involves a shift in emphasis from an informational and gnostic approach to a developmental and active one, based on the formation of a personality capable of active, creative activity" (Terno, 2023).

The development and formation of the humanistic paradigm are the main characteristic features of modern education. It is this kind of education that highlights the significance of the dignity and value of people to increase their activities, independence, and freedom.

The creation of personally-oriented situations requires a personally-oriented learning technology that requires the student to adapt to his own interests, search for meaning, create a model or image of his own life, and choose a critical assessment and creative direction. These tasks require cognitive searches, not just existing knowledge. To effectively master technology, a student must be able to reflect during the learning process. Taking into account the individual characteristics of the student in the educational process is one of the typical features of the personally-oriented training of its participants: students, teaching staff, etc. (Shetelya et al., 2023).

Interactive learning technologies can be divided into the following groups:

- Frontal technologies ("brainstorming", microphone, openwork saw, "unfinished sentence";
- Interactive collective and group training (work in pairs, rotating threes, "Two-four – all together", "Aquarium", "Carousel", work in small groups);
- Situational training ("Dramatization", "Roleplay", "Simplified court hearing");
- Training in discussion ("Method press", "Decision tree", "Discussions", and "Take a position" (Koval, 2016).

It is important during the formation of students' creative abilities to follow the stages of their development, taking into account the levels of formation of students' knowledge qualities (Plakhotnik et al., 2023):

Level 1 – reproductive – involves the reproduction of activity methods and knowledge;
Level 2 – constructive – means the ability to transform acquired knowledge into similar learning situations that require the ability to analyze and synthesize, constructive thinking, and repetition of tasks;
Level 3 – creative nature of activity – is manifested in the ability of students to creatively apply their knowledge in non-standard situations and look for new ways of thinking (Shunkov et al., 2023).

Distance and media technologies of education. In the context of the information society, in the conditions of the rapid development of distance learning, an innovation in the educational process is distance and media learning technologies, which involve the use of telecommunication and computer technologies, with the help of which participants in the educational process are provided with interactive interaction (Rebukha & Polishchuk, 2020).

Modernization of higher education in modern conditions is being actively carried out. Digital transformation is an important aspect of higher education. Remote service systems are popular in the educational process, including Moodle, Microsoft Teams, Zoom, Google Meet, and Google Classroom.

The formation of a digital society is a driver of the formation of a digital economy and digitalization of education. Given the transition of society to the blockchain, a new level of the Internet of Things, the development of big data processing technologies, intelligent and informational digital technologies, and

informatization, the era of digitalization is moving to an innovative level of development (Poddenezhnyi, 2021). That is, the era of informatization and computerization of modern society has changed to the era of digitalization (Zaspa, 2021). For the first time, the concept of digitalization was introduced by the American scientist in the field of computer science N. Negroponte (1996) and considered a process of transition from the processing of atoms to the processing of bits.

The development of flexible adaptation skills of people is conditioned by the digitalization of education, in particular, to changes in the professional environment and society (Selwyn, 2016). Marvin Minsky (2007) notes the unique opportunities for human development to improve critical thinking in the digital environment and emphasizes the special role of a unique feature of a person in this environment, which is the flexibility to "switch" any actions and mental processes between different ways of performing professional tasks.

To increase critical thinking, the following expected results of digitization of education are determined:

− Ensuring the opportunity for students to form an individual educational trajectory to improve critical thinking through the wide use of modern control and diagnostic tools and electronic resources (Puhach et al., 2021);
− Formation of a unified academic and information environment "offline" and "online", expansion of opportunities for collective work and university communication (Buinytska et al., 2020);
− As an alternative to the teacher's digital profile and the classic scorebook, the creation of a student's digital profile that reflects the results of innovative, scientific, pedagogical activities (Havrilova & Topolnik, 2017);
− Material support of the educational process and implementation of its automation planning in making management decisions on the use of data regarding the course of education (Poddenezhnyi, 2021).

The emergence of innovative technological means of learning, such as smart boards, laptops, mobile devices, tablets, MOOCs (Massive Open Online Courses), virtual laboratories, dynamic visualization technologies, etc., has led to the improvement and creation of an innovative educational process in higher education. In the educational field, the use of remote platforms for learning is becoming more and more popular and widespread due to modern reality. These technologies bring the educational process to a fundamentally new qualitative level. It is worth emphasizing the importance of modern digital tools, in particular, augmented and virtual reality applications, used for remote training of future specialists.

Cooperation technologies (partner technologies) in the educational process of a higher school. In general, partnership pedagogy is based on the cooperation of students and teachers and their communicative interaction, on the unification of aspirations and common goals, fostering responsibility for their results, and on the equality of process participants. The phenomenon of cooperation is implemented between different social groups as a means of interaction, as a special mechanism of social relations between educational institutions, employers, and employee representatives, and is the result of the development of cooperation pedagogy (Terno, 2023).

Project activities involve teamwork, so a large amount of information in the process of working on a project forces students to unite. It must be worked out with the help of technologies that must be applied, which contributes to the formation of a socialized personality and its formation. Working in a team, students learn to resolve possible conflicts, communicate with each other, take responsibility for their choices, acquire ethical interpersonal communication skills, analyze performance results, and make decisions independently.

Modular rating learning technology. It includes the modular rating technology of education: through modular programs, the methodology of designing the content of education, principles, target components, a system of forms, methods, and means of education, and monitoring the results of educational activities. A comparative analysis of modular training and traditional training shows the advantages of modular training:

− In this type of activity, the goals of studying the educational material are formed and presented to students before the start of training, and during the individualized educational process, the activity with a mandatory learning outcome is aimed mainly at learning the educational material;
− Various methods are used to implement educational tasks, often developing and active;

- Modular training takes place at a time convenient for the student and in any place, depending on the intellectual capabilities of the student, which is very necessary for improving students' critical thinking, which is important in an individualized education system;
- Control is carried out in stages – as the module or the entire program of the module is mastered;
- Thanks to the creation of certain didactic conditions, the modular rating system largely neutralizes the shortcomings of traditional education (Rebukha et al., 2022).

Experiment.

The program and methodology of research and experimental work to check the effectiveness of the system for raising the level of critical thinking of students using innovative technologies was carried out in several stages with the determination of scientific and pedagogical methods and tasks of research organization.

The first stage – informational, consisted of forming students' ideas about the specifics of the future professional activity in the conditions of modern society.

The second stage – the technological stage consists of the formation of future specialists' skills and abilities to realize the purpose, functions, and tasks of professional activity in the conditions of education, training, and development in mastering general pedagogical, creative technologies to increase the level of critical thinking of students.

The third stage – the creative stage, consists of the formation of the ability to reflect, master the system of increasing the level of critical thinking of students, the experience of professional activity of the future specialist, improvement of professional skills and professional activity skills through the introduction of innovative technologies.

A representative sample of the number of students was determined for experimenting with higher educational institutions.

One hundred four students were involved in the ascertainment stage of the experiment. The control group consisted of 54 people, and the experimental group – 50 respondents of higher education institutions.

At the ascertainment stage of the experiment, the following trend is observed (Fig. 1):

- The dominance of the reproductive level of students' critical thinking and professional readiness of future specialists 56% – in CG and 58% – in EG;
- The constructive level of students' critical thinking and professional readiness of future specialists is 21% – in CG and 17% – in EG;
- The productive and creative level of critical thinking of students and professional readiness of future specialists, respectively, is 11% – in CG and 12% – in EG;
- The elementary level of students' critical thinking and professional readiness of future specialists is determined by indicators of 12% – in CG and 13% – in EG.
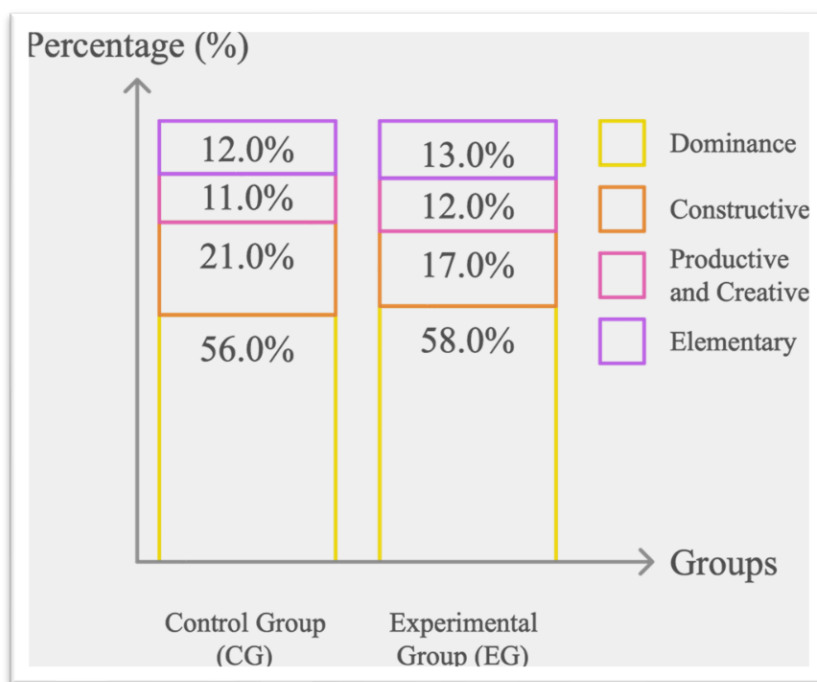
Figure 1. Critical thinking and professional readiness levels of students.

After the formative stage of the experiment, we found positive dynamics of increasing the level of critical thinking of students and the professional readiness of future specialists in EG, while in CG, these changes turned out to be practically unchanged.

The conducted diagnostics of the system for increasing students' critical thinking and professional readiness of future specialists allowed us to talk about integrated indicators of the formation of professional readiness of future specialists and increasing students' critical thinking at the formative stage of the experiment.

The data of the control section proved that the graduates of the higher school (Fig. 2):

− The productive and creative level of critical thinking of students and the formation of professional readiness of future specialists was recorded in CG in 9% of people – after its completion (in EG, this indicator is 22%, respectively);
− Constructive level – in CG at its completion – 24% – (in EG, we observe much higher results – 38%);
− Reproductive – showed almost the same number of CG students at the end of the experiment – 58%, while in EG, the number of students changed significantly – 33%;
− Elementary – in CG, the total number of respondents changed accordingly -10%, and in EG, this number decreased significantly to 8%, which is an increase.
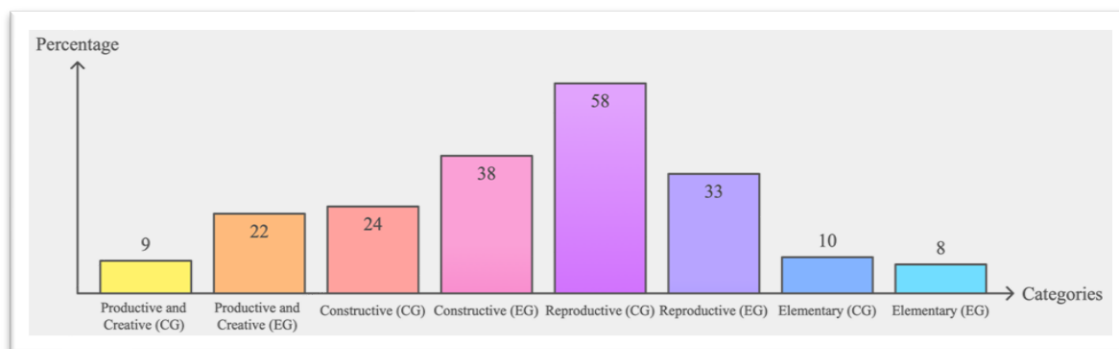

Figure 2. Comparison of critical thinking and professional readiness levels.

The increase in critical thinking of students and the formation of professional readiness of future specialists by all indicators is 15%, which is a positive result. With the help of K. Pearson's linear correlation method, the Kolmogorov-Smirnov statistical criterion, and the E. Pustilnyk method, the reliability of the obtained data was checked using the SPSS Statistics 17.0 package to check the compliance of empirical data with the laws of factor analysis and normal distribution.

Positive changes in the levels of student's critical thinking and the formation of professional readiness of future specialists in EG compared to CG were revealed. The increase in the level of this readiness among EG students is due to the introduction of the author's system for improving students' critical thinking using innovative technologies. According to all indicators, the increase in students' critical thinking using innovative technologies and the formation of future specialists' professional readiness at the experiment's formative stage is 15%, which is a positive result.

Qualitative research methods are used mainly to identify the problem and develop hypotheses. Also, they can be used as a preliminary before quantitative studies to determine the main indicators. Due to the small size of the research group of respondents, the results of qualitative research cannot be generalized to the entire population. However, they can be extremely useful for studying this or that issue and evaluating different programs. In addition, qualitative methods allow, unlike quantitative methods, to reveal people's internal motives and motivations.

The main difference between qualitative methods and quantitative methods is that in the first case, data is collected from a relatively small group of respondents and is not analyzed using statistics, while when using quantitative methods, a large group of people is studied, and the data is further analyzed using statistical methods. One of the most popular methods of qualitative research is the method of focus group discussions. Qualitative research methods are characterized by the fact that experimental data are collected from a relatively small group of respondents and are not analyzed using statistics, so we used quantitative methods in the study to study a large group of people, and subsequently, the obtained data were analyzed using statistical methods.

Our research depends on the accuracy and reliability of the data. In the framework of research work, the quality of data collection and analysis not only adds weight to the research but also contributes to the formation of sound conclusions, which is the key to academic success.

The following quantitative data collection tools were useful in the study:

− Google Forms – a simple tool for creating surveys that allows you to collect data from respondents, create questions of various types, and collect answers in spreadsheets.
− SurveyMonkey is a modern survey tool that offers a wide range of customization options and analytical tools for analyzing the collected data.
− Google Scholar and other academic search engines provide access to scholarly articles, books, and other academic resources that may be useful for literature review and theoretical data collection.

Taking into account the connection of our research with the previous literature, we note that for the educational practice of students of higher education institutions, the development of a methodology for the development of critical thinking in the process of informatization of society, which encourages the introduction and development of innovative means, methods, and forms that contribute to the development of the ability to distinguish between unreliable and reliable information, critically evaluate information, separate the necessary information from information flows, etc. and shows the importance of developing educational and methodological materials for the development of student's critical thinking using innovative technologies and improving the process of their professional training.

Disadvantages during the work were insufficient development of methods for working with artificial intelligence to process large amounts of information, identifying fakes, lack of an interactive board to improve students' critical thinking, which would allow higher education students to absorb 1.5 times more information, and increase student interest is more than 2 times higher.

The research had limitations regarding the identification of variable means of applying innovative learning technologies in the educational space of a higher educational institution and their impact on the creative side of students studying in a higher education institution.

Conclusions

The article examines and experimentally verifies the increase in the level of critical thinking of students and the professional readiness of future specialists through the use of innovative technologies. The content and level of critical thinking are revealed. The key provisions of the philosophy of education, on which the organization of the development of critical thinking of students of higher education should be based, are highlighted. Six levels of the process of formation of critical thinking skills and the most important factors and components of the development of critical thinking are considered. The four most important factors in the development of critical thinking and groups, types, and systematics of pedagogical innovations to improve students' critical thinking are analyzed. Ways of using innovative technologies to increase the level of students' critical thinking are substantiated. The main features of the modern stage of digitalization of education are named, which are necessary for increasing the critical thinking of an individual and the integral implementation of the relationship in the construction of the educational process of a higher education institution.

The conducted diagnostics of the system for increasing the level of students' critical thinking and the professional readiness of future specialists allowed us to talk about the integrated indicators of the formation of the professional readiness of future specialists and the improvement of students' critical thinking at the formative stage of the experiment.

Positive changes in the levels of student's critical thinking and the formation of professional readiness of future specialists in EG compared to CG were revealed. The increase in the level of this readiness among EG students is due to the introduction of the author's system for improving students' critical thinking using innovative technologies.

Nowadays, a person's ability to make a responsible decision is determined by his ability to process information and form his own assessment of events, facts, and processes on this basis. Therefore, on the one hand, it is important to prepare young people to quickly perceive educational information, analyze large volumes of data to make informed decisions, use electronic resources for their own improvement, and, on the other hand, form in them the ability to argue their professional position, critically evaluate their own achievements and achievements others, respect the views and accept the position of colleagues on various issues.

Technology for the development of critical thinking forms creative thinking and promotes the development of creativity. Critical thinking is necessary when solving problems, formulating conclusions, evaluating, and making decisions. Perception, understanding, awareness, and assimilation of educational information require active mental activity, including critical thinking.

So, the relevance, insufficient development of the raised problem of innovative technologies in the development of students' critical thinking and the need to solve them at the scientific-theoretical, methodical, and practical levels led to the choice of the research topic and the experiment proved the importance of using innovative technologies in the development of students' critical thinking.

Further research is needed to build a structural-functional model of the process of raising the level of critical thinking of students in a certain direction, the core of which is the ability to self-improvement the individual, the graduate's readiness for professional activity at a high scientific and pedagogical level, self-development.

The issue of training future specialists and practicing teachers for the formation of critical thinking of students of basic and specialized general secondary education needs further study. Therefore, we see the prospect of further research in the development of content and technologies for the training of teachers of a higher education institution for the formation of critical thinking of future specialists and practicing teachers of various specialties.

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