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Development of creative competence in university students through information technologies: an experimental study

Desarrollo de la competencia creativa en estudiantes universitarios a través de las tecnologías de la información: un estudio experimental

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Abstract

The article reveals the content of the concept and the main indicators of creative competence. The article aims to verify the developed and research-based pedagogical conditions for training specialists for the

formation of creative competence in professional activity using information technologies. Regarding the research methodology, we used quantitative methods of data analysis. This group of empirical research methods includes obtaining information about the object under study that allows us to identify its quantitative characteristics. When determining the sample of subjects, the general specificity of the research subject was considered. The total sample size was 120 subjects. When forming the sample, the criteria of content, representativeness, and equivalence were taken into account. As a result of the experimental work, according to all the specified criteria and indicators, a positive dynamic of creative competence was formed due to the use of modern information technologies among EG students, which confirms the significant influence of the specified pedagogical conditions on the preparation of students for the manifestation of creative competence in professional activities.

Keywords: professional training, modern information technologies, professional activity, students, formation of creative competence.

Resumen

El artículo revela el contenido del concepto y los principales indicadores de la competencia creativa. El objetivo del artículo es verificar las condiciones pedagógicas desarrolladas e investigadas para la formación de especialistas en el desarrollo de la competencia creativa en la actividad profesional mediante el uso de tecnologías de la información. En cuanto a la metodología de investigación, se emplearon métodos cuantitativos de análisis de datos. Este grupo de métodos de investigación empírica incluye métodos para obtener información sobre el objeto de estudio que permiten identificar sus características cuantitativas. Al determinar la muestra de sujetos, se tuvo en cuenta la especificidad general del sujeto de investigación. El tamaño total de la muestra fue de 120 sujetos. Al formar la muestra, se tuvieron en cuenta los criterios de contenido, representatividad y equivalencia. Como resultado del trabajo experimental, de acuerdo con todos los criterios e indicadores especificados, se formó una dinámica positiva de la competencia creativa debido al uso de tecnologías de la información modernas entre los estudiantes del GE, lo que confirma la influencia significativa de las condiciones pedagógicas especificadas en la preparación de los estudiantes para el desarrollo de la competencia creativa en las actividades profesionales.

Palabras clave: formación profesional, tecnologías de la información modernas, actividad profesional, estudiantes, formación de la competencia creativa.

Introduction

Today, the task of higher education is not only to increase the level of professional competence of graduates, but also to form a mobile, creative, socially stable personality, able to adapt to modern conditions, ready for self-development, and effective application of this knowledge in professional activities. Based on this, in the formation of creative competence of students through the use of modern information technologies, an important role is assigned to higher education, which aims to reveal the personality of a person; to educate in his interest in acquiring knowledge, in the educational field; to form a modern citizen adequate to modern life, possessing innovative high-quality knowledge (Harashchuk & Kutsenko, 2022).

The need of the present is to improve the preparation of students for the formation of creative competence in professional activity through the use of modern information technologies, which is based on innovative teaching of creative technologies. Therefore, comprehensive education and training of specialists who have the skills of adaptation to changing conditions, high creative potential, and skills to meet the requirements of the labor market is one of the fundamental tasks of the education system.

Thus, the question arises of the need to optimize the educational process, find new ways and means of forming creative competence, apply effective innovative technologies, and create favorable conditions for the realization of students' creative abilities. In this regard, there is a growing need to develop innovative teaching methods that are implemented within the framework of educational models that are creative and

ensure an increase in the quality of higher education as a whole. This is precisely what determines the relevance of the article (Kalinina, 2017).

Practice shows that, for example, when using information technologies in education, such as text information, the intensity of learning is 20-25%, and when using sound media, this figure increases to 45-50%, while when using them together (text, sound and video information) – 70-75%. The use of information and technical achievements in education increases the effectiveness of the educational process, arousing students' interest in working with modern equipment, thus increasing their motivation for learning; expands the possibilities for presenting information through the use of multimedia; provides access to learning sources – databases, knowledge bases; provides flexibility of learning strategies, etc.

Analysis of theoretical developments of scientists on the development of competencies using information technologies in terms of the formation of creative competence in them made it possible to state several contradictions between:

- Global trends that actualize the need for a creative approach to the problems of modern high-tech production, which increases the requirements for the quality of training of specialists, and the insufficient orientation of educational institutions on the development of creative competence of future specialists as an integral characteristic of their effective performance of professional functions;
- The desire of university students to be competitive in the labor market and their insufficient understanding of the significance of the formation of creative competence as a personal and professional characteristic of a sought-after specialist;
- Teachers' awareness of the importance of forming in students a readiness to actively demonstrate creative competence in future professional activities, and the insufficient development of pedagogical conditions and means of their implementation concerning the specified competence.

Therefore, the study of the process of developing creative competence of future specialists is a relevant and important task that meets the requirements of the modern social environment and professional standards.

The relevance of the problem raised, the theoretical and practical benefits of its solution, its insufficient development in pedagogical science, as well as the need to eliminate the identified contradictions, determined the choice of the topic of the article.

Literature Review

An appeal to the scientific discourse of recent decades shows that the problem of creativity, creative abilities, and creative thinking is widely represented in the works of foreign and domestic scientists.

Several scientists distinguish a separate type, creative giftedness, as the potential of an individual and their readiness for creative activity. One of the new scientific perspectives is the study of creativity, the ability to make innovative decisions, critical thinking in the context of classification and explanation of "soft skills" as important skills of the 21st century. Analysis of the works of Klochko, Nagayev, Kovalenko & Fedorets (2020) shows that “man has always strived for creative self-expression”. Creative abilities are considered by scientists as those that “correspond to general giftedness, that is, they are prerequisites for highly effective intellectual activity”. Authors proved that “during the creative process, the harmonization of the personality as a system occurs, and in the act of creation, a person is freed from previous tension. As a result of tension relief, harmonization occurs between the elements of the system”.

Among the studies of giftedness and creativity, many works reveal the psychological properties that characterize a gifted, creative person. The main place in the preparation of specialists for the formation of creative competence in professional activity is occupied by the development of the creative potential of giftedness. Methodological, scientific-theoretical, and applied aspects of the formation of creative

competence in the professional activity of future specialists are considered by Harashchuk & Kutsenko (2022). Scientists revealed the components of creative resources (intellectual abilities of a person, the personality itself, environment, knowledge, thinking style and motivation), which contribute to the ability of a future specialist to integrate knowledge, to the formation of developed professional thinking at different functional levels; they substantiated the principled approaches to the formation of creative specialists, the essence of competence and competence of an employee in the educational sphere, ways to develop motivation in a future specialist to master quality knowledge, to study. In the psychological and pedagogical discourse, there is a fairly wide range of research devoted to various aspects of creativity as an important feature of every teacher. We share the position that every stage of pedagogical activity should be carried out based on creativity, and creativity should "permeate" all components of the educational process. The problems of forming creative competence of students in higher education are considered by Kalinina (2017). At the same time, students' abilities to be creative are a component of professional competence and an important professional quality of the personality. "It is substantiated that the use of information technologies in the educational process contributes to the formation of creative competence of university students".

In recent years, pedagogical creativity has been considered within the framework of the implementation of the competency-based approach, which is actively developed in modern theory and is gradually being introduced into the practice of educational institutions. This problem is considered in the article by Sokół, Figurskab, and Blašková (2015). The main scientific goal of the article by these scientists is to study and investigate the frequency of Internet use in the educational process in selected higher educational institutions using scientific procedures and appropriate methodology to determine the impact of online learning on the competencies of professional creativity of human capital. The results obtained became the basis for formulating the research hypothesis: the higher and more developed the ability to use the Internet in the educational process, the higher the level of competencies of professional creativity of human capital, which as an element of intellectual capital is an important factor of development at the micro- and macro-regional levels.

The variety of innovative technologies includes Internet technologies, which involve the interaction of all participants in the educational process, which is carried out using methods that activate pedagogical communication, as an equally active intersubjective interaction. Innovative technologies help to intensify independent creative work, which contributes to the development of creative skills and cognitive activity. In particular, the scientist Norqulov (2024) in the article explores the formation of creative competence in students through the integration of innovative technologies in education. It emphasizes the importance of creative competence, which is defined as the ability to generate new ideas, solve problems, and adapt to new situations, which is crucial for success in the 21st century. The article examines various innovative technologies, such as multimedia tools, virtual and augmented reality (VR and AR), artificial intelligence (AI), and digital platforms, emphasizing their role in improving students' learning experiences and developing creativity.

A thorough analysis of research on this issue allows us to conclude that in the process of training specialists, more attention should be paid to the formation of creative competence through the use of modern information technologies, the formation and development of students' creative activity, the development of creative abilities, imagination, fantasy, skills, etc.

Paying tribute to the scientific achievements of the listed researchers, taking into account the realities of today, there is a growing need to continue scientific research in terms of developing theoretical and methodological foundations and developing practical recommendations for the development of creative competence in university students using information technologies. Therefore, clarifying the essence of creative competence, conducting an analysis of the state of development of the labor market and higher education in Ukraine, monitoring the employment and career growth of graduates, and developing ways to develop creative competence in university students using information technologies requires a comprehensive solution to these problems.

The theoretical significance and practical necessity of developing creative competence in university students using information technologies, insufficient scientific and applied development of these issues, determine the relevance of the problem and the choice of the topic of the article, outlining its purpose and structure.

PURPOSE OF THE ARTICLE. Verification of the pedagogical conditions developed and substantiated in the research for the training of specialists for the formation of creative competence in professional activity using information technologies.

Methodology

To achieve the set goal, a set of research methods was used at the following stages of the study:

- *Theoretical:* to highlight the state of the research problem − analysis of scientific literature; to clarify the state of development of concepts of the research issue − synthesis, generalization, comparison, systematization of theoretical data;
- *Empirical*: pedagogical experiment, observations, conversations, questionnaires to determine the level of formation of creative competence through the use of modern information technologies;
- *Mathematical statistics*: for mathematical processing of diagnostic data, establishing the reliability of conclusions, and determining the significance of results.

When determining the sample of subjects, the general specificity of the research subject was taken into account. The total sample size was 120 subjects. The control group contained 60 respondents, and 60 in the experimental group. 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 implementation of the pedagogical experiment was carried out in three stages: preparatory, main, and final.

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

At the main stage, the experiment was conducted.

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

The experiment was conducted during 2023-2024.

The experiment involved bachelor's degree students in socio-economics who are in their 1st-3rd year of university.

The experiment was conducted in Rivne State University of Humanities, Municipal Establishment «Kharkiv Humanitarian-Pedagogical Academy» of Kharkiv Regional Council, Sumy State Pedagogical University named after A. S. Makarenko, National University of Life Resources and Environmental Management of Ukraine. 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 reliability and validity of the obtained results, the objectivity of their assessment were ensured by the methodological justification 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 the experimental and control data collection, statistical processing was carried out using MS Excel and SPSS (Statistical Package for Social Science) programs.

In our article, we used quantitative methods of data analysis. This group of empirical research methods includes methods of obtaining information about the object under study that allow identifying its quantitative characteristics.

We have implemented pedagogical conditions for creative competence in university students using information technologies.

The first condition was the creation of a creative environment using ICT.

The choice of technologies was based not only on the requirements of society, but also on the individual characteristics of the student. Expressive means of digital resources (computer graphics, video clips) open up opportunities to stimulate the emotional perception of educational messages, this is achieved through figurative vision, emphasizing the main idea in the frame, dynamic editing, etc. Currently, the term "visual thinking" is becoming increasingly widespread, which is defined as "human activity, the product of which is the generation of new images, the creation of new visual forms that carry a certain semantic load and make knowledge visible."

Increasing the creative activity of students in the educational process using digital resources is determined by the following motives:

- Exceptionally wide possibilities of digital resources for individualizing education;
- Providing a wide field for active, independent activity of students;
- Ensuring a wide area of contacts; the ability to communicate via the Internet with any person, regardless of their spatial location and time zone differences;
- High clarity of presentation of educational material, especially when modeling phenomena in dynamics, demonstrating fast-moving and very slow processes (the possibility of time transformation), volumetric or, conversely, microscopic objects (the possibility of space transformation);
- Growing interactive capabilities;
- Accessibility;
- Multiple acceleration and reduction of the mass of routine operations (for example, such as the production of volumetric calculations, graphing, modeling phenomena, documenting the results of learning and research, etc.).

The second pedagogical condition is the development of the student's creative potential, which stimulates creative activity through the use of various types of digital resources. These are: purposeful creation of conditions and stimulation of the creative process for each student; creation of open learning situations, consideration of alternative points of view and approaches; creation of conditions for eliminating conformism; creation of a positive emotional background for learning, and elimination of stress factors in classes. Using educational platforms (such as Moodle, Google Classroom) in experimental groups.

The third pedagogical condition is the creation of a special course. The special course is aimed at the practical mastery of creative practices that form individual and socially oriented technologies in the development of a teacher's creative competence. Practical mastery of creative technology groups will contribute to the preparation of socially active, creative, creative specialists in the field of information technologies in the process of advanced training, capable of self-improvement, self-determination, and self-actualization with the skills of individual and team creative activity. In the process of gradual mastery of the special course, students should realize: the role and importance of the creative component in the formation

of an innovative education system and the heuristic potential of the introduction of innovative technologies for the formation and development of creative competence.

These pedagogical conditions not only provide an opportunity for a student at each educational level to develop their original creative potential, but also awaken the need for further self-knowledge, creative self-development, and form an objective self-esteem in a person.

Results and Discussion

The content of the concept and the main indicators of creative competence, qualities that are distinguished in the structure of the creative competence of the individual.

The activity, the result of which is the creation of spiritual and new material values, is creativity. Creativity has procedural, personal, and psychological aspects and assumes the presence of knowledge and skills, motives, and abilities in the individual, thanks to which the creative product is created and is distinguished by uniqueness, originality, and novelty (Dermendjieva & Tsankov, 2023). The study of such personality properties revealed the important role of fantasy, intuition, and imagination as unconscious components of mental activity, as a person's need to expand and reveal their creative capabilities, in self-actualization (Kalinina, 2017).

We support the opinion of Ziaziun (2011) that “creative competence is a complex personal formation that includes intellectual, emotional, moral and other acquired knowledge, skills and abilities, which allows, at a fundamentally new, integrative level, to transfer acquired competencies from one sphere of life to another, to achieve a fundamentally new result of activity or perform activity at a fundamentally new qualitative level”.

A creative personality is distinguished by a high level of development of motivation for creativity, is characterized by the formation of a wide range of qualities and properties, has a high level of intellectual development, is characterized by independence and originality of judgments, developed fantasy and imagination, richness of the inner world, sensitivity to the unusual and new, intuitive foresight, self-confidence, a developed "I" concept and ingenuity and initiative. The manifestation of these qualities and properties of a person indicates the formation of the creativity of the individual, a high level of personal development (Tkachenko, 2014).

The main indicators of creative competence are: innovative, informational, creative, research competence, because it is the curiosity of the mind, search activity that characterizes a creative personality, and finding and searching for an effective and new solution – the innovative orientation of a specialist who has creativity, that is, the necessary potential (Ho & Shih, 2023).

So, creativity is the ability to deeply understand one's experience, the ability to find solutions in non-standard situations, the ability to learn and be surprised, and the ability to discover something new (Puhach et al., 2021).

The creative competence of a modern specialist includes a system of personal qualities, skills, abilities, and knowledge, which are necessary for creativity. The creative component can be in any type of pedagogical, organizational, or communicative activity of a person. The emphasis is, in this context, on the research component of a person's professional activity (Illyakhova, 2018).

Let's highlight the qualities that are distinguished in the structure of the creative competence of the individual. These are:

- The ability to solve problem tasks, to be creative, flexibility, ingenuity, critical thinking, self-confidence, and originality of a person, intuition; the ability to solve and set non-standard tasks, the ability to transfer experience, the ability to synthesize, analyze, combine, predict, etc.;
- Emotional and imaginative qualities;
- Emotional uplift in a creative situation; the ability to empathize (empathy), associativity, spirituality, a sense of novelty, imagination, sensitivity to contradictions;
- Overcoming stereotypes; insight, the ability to see the familiar in the unfamiliar; the desire for freedom, a tendency to take risks (Shetelya et al., 2023).

Analyzing creative abilities, let's determine the properties inherent in a creative personality and identify criteria for assessing a person's ability to think creatively and exhibit innovative personality traits.

Analyzing creative abilities, we will define the properties inherent in a creative personality:

- High level of scientific talent;
- Spontaneous curiosity;
- Tendency to ask questions;
- Interest in the complex and incomprehensible;
- Sense of responsibility for the development of science;
- Ability to spend a long time solving one problem (Lu et al., 2022).

Let's list the possibilities of scientific talent that involve the development of a personality:

- The ability to reproduce and remember a large amount of information for a long time;
- The creative thinking of a person.

You can use the criteria for assessing the individual's ability to think creatively:

- The degree of complexity of the mental task that the student solves and the speed with which the person solves mental tasks;
- Imagination – the ability to imagine something new visually that has not been encountered before in experience. Imagination plays a particularly important role in phases of scientific research, such as building and testing a hypothesis, a thought experiment (Shyshkin, 2016).

In addition to scientific talent, for the success of scientific research work, a student must have innovative personality traits:

- Diligence – the ability to work long hours;
- Discipline;
- The ability to criticize and self-criticize;
- Enthusiasm for one's work and its tasks;
- The ability to communicate with people (Savchenko et al., 2024).

The task of higher education is to activate the creative potential of the student during the educational process and to develop in future specialists of innovative digital technology the formation of creative competence by the requirements of modern society (Todorova, 2024).

Signs and principles that characterize creative education. The role of self-movement, self-affirmation, independent work, self-improvement, self-education, self-knowledge, self-regulation, self-determination, and self-realization in preparing students for the formation of creative competence in professional activity through the use of modern information technologies.

Let us name the features that characterize creative education: orientation towards the development of the creative potential of educational technologies, systematic construction of the educational process, positive motivation for creativity, balance of practical skills and theoretical knowledge, diversity of teaching methods, continuous development of knowledge and problem-solving, active participation in the formation of students' educational programs (Fedulova & Shovkun, 2009).

Active use in education of computer laboratory workshops, activities of training modules and cases, electronic tests and textbooks, demonstration materials, multimedia presentations, virtual business games, electronic full-text textbooks, multimedia training programs is important in preparing specialists for the formation of creative competence in professional activity (Knysh et al., 2024).

Proper management of educational development risks contributes to their successful use by adhering to the following principles:

- Successful combination of the technical component of education and the humanitarian component of education;
- Openness to all segments of society and accessibility of education;
- Implementation of applied scientific and fundamental research;
- Implementation of factors and their search, compliance with which contributes to the reduction of dangers and risks of losses (Vanutelli et al., 2022).

All this has a positive effect on the acceleration of the innovative economy, on the formation of a socially-oriented, creative economy, where education, in particular digital, plays a decisive role precisely in the formation of a society of happy people, and not just creative individuals (Harashchuk & Kutsenko, 2022).

Organization of experimental work.

In order to verify the pedagogical conditions developed by us and substantiated for preparing students for the formation of creative competence in professional activity through modern information technologies, we organized a pedagogical experiment that included the traditional stages for pedagogical research: ascertaining, forming. The experiment was held in the natural conditions of the university educational process.

At the stage of ascertaining the experiment, the goal was set to clarify the state of the problem of forming creative competence in students through the use of modern information technologies and readiness to reveal creative competence in their future professional activity. A questionnaire was conducted, in which 120 students – future specialists in socionomic specialties, studying in the 1st-3rd years of universities, participated.

In the structure of students' creative competence, we consider it appropriate to distinguish the following components: motivational, cognitive, activity, and reflective. We believe that the interaction of these components encompasses knowledge and skills, personality traits necessary for the professional preparation of university students to demonstrate creative competence in professional activities.

We have determined the criteria and indicators of the formation of creative competence in students through the use of modern information technologies and readiness to demonstrate creative competence in their future professional activities, during the study.

Motivational criterion.

Indicators: creative motivation (for professional realization – the need to be creative, the presence of motives that actualize creativity); creative attitude to the future profession (awareness of the need to demonstrate creativity in the profession, value orientations).

Personal criterion.

Indicators: creative potential of the student's personality (intuition, imagination, curiosity, originality, sense of humor and optimism, creative problem solving, emotionality); reflective skills (skills of self-organization and self-realization, skills and abilities of self-analysis and analysis of the collective creative activity of the group, one's own creative activity).

Cognitive criterion.

Indicators: effectiveness of knowledge (nature and completeness of knowledge), that is, the presence of knowledge of basic creative techniques and their innovative application in practice; features of the manifestation of creative thinking (adequacy, flexibility, originality, speed) in the field of informatization of education, which make the existence of creative activity possible; associative thinking (verbal creativity); divergent thinking (non-verbal creativity).

The formation of these criteria determines the readiness of future specialists to identify creative competence through the use of modern information technologies and the manifestation of readiness to apply creative competence in their future professional activities.

We have identified three levels of assessment of the formation of students' creative competence for each criterion: high, medium, and low.

We began the diagnosis of the level of formation of creative competence of university students using the motivational criterion.

At the ascertaining stage of the study:

- 18% of respondents from the CG and 19% of respondents from the EG have a high level of motivation for success;
- 39% of representatives of the CG and 39% of the EG have an average level of motivation for success;
- 43% of the CG and 42% of the EG have a low level of motivation for success.

Table 1.
Students' motivation for success

Groups	Levels		
	High	Average	Low
KG	18	39	43
EG	19	39	42

As a result, at the ascertaining stage:

- 20% of students from the CG and 19% of students from the EG have a high level of motivation for success in terms of the general indicator of attitude to the future profession;
- Low level according to the general indicator of attitude to the future profession, that is, unawareness of the need to obtain knowledge and skills and the importance of creativity in professional activity and insufficient desire to demonstrate creative abilities in the field of informatization of education, the lack

of need to creatively solve professional tasks was demonstrated by 44% of respondents in the CG and 40% of respondents in the EG.

Table 2.
Motivation for success by general indicator of attitude towards future profession

Groups	Levels	
	High	Low
CG	20	19
EG	44	40

In the aggregate of all indicators of the motivational criterion, a high level was demonstrated by 19% of respondents in the CG and 19% of respondents in the EG. Thus, the low and approximately equal initial level of formation of creative competence in the field of informatization of education, according to the motivational criterion of university students, was confirmed using objective diagnostics.

Identification of the level of development of reflectivity and creative potential in future specialists was provided by the diagnostics of the personality criterion.

A high level of personal creativity is inherent in a student who has developed creative potential, is persistent, proactive, active, can use innovations, independence, willingness to take risks, emotionality, a sense of humor and optimism, which contribute to providing the creative process with positive emotions, etc.

According to the results of the ascertaining experiment:

- A high level was found in 32% of respondents in the CG and 33% of respondents in the EG;
- A low level of personal creativity was shown by 29% of respondents in the CG and 29% of respondents in the EG. A low level is characteristic of a student whose creative potential is not sufficiently developed, who lacks initiative and passive participation in professional activities, and who is prone to obeying the majority opinion.

Table 3.
Results of the ascertaining experiment

Groups	Levels	
	High	Low
CG	32	29
EG	33	29

The survey at the ascertaining level revealed the following results:

- A high level of reflectivity, adequacy of self-assessment of creative potential, ability to reflect on activities, ability to think about one's activities, carefully plan them, and predict possible consequences was demonstrated by 17% of respondents in the CG and 20% of respondents in the EG,
- An average level of reflectivity was demonstrated by 44% of respondents in the CG and 45% of respondents in the EG,
- A low level was demonstrated by 39% of respondents in the CG and 35% of respondents in the EG.

Table 4.
Levels of reflexivity, adequacy of self-assessment of a student's creative potential

Groups	Levels		
	High	Average	High
CG	17	44	39
EG	20	45	35

Diagnostics of the cognitive criterion at the ascertaining level involved determining the features of the manifestation of creative thinking, the manifestation of knowledge in the informatization of education, and identifying in students the initial level of effectiveness of knowledge necessary for the formation of creative competence, and showed the following results:

- A high level of creative competence was shown by 28% of the CG respondents and 30% of the EG respondents,
- An average level was shown by 37% of the CG respondents and 36% of the EG respondents,
- A low level of creative competence was shown by 35% of the CG respondents and 34% of the EG respondents.

Table 5.
Diagnosis of the cognitive criterion at the ascertaining level

Groups	Levels		
	High	Average	High
CG	28	37	35
EG	30	36	34

Thus, the vast majority of the EG and CG respondents, according to this criterion, showed a generally insufficient level of readiness to reveal creative competence.

Quite low results were found for almost all indicators, which indicates the need to develop and implement pedagogical conditions to increase the level of formation of all indicators of the identified criteria of readiness to reveal creative competence of students as a whole.

The data from the ascertaining experiment allowed us to determine the guidelines with the students of the EG during the formative stage of the experiment.

At the formative stage of the experiment, pedagogical conditions for preparing students for the formation of creative competence in professional activity through the use of modern information technologies were developed and implemented in the EG:

- The first pedagogical condition: creating an educational, creative environment through the use of modern information technologies in the process of professional training;
- The second pedagogical condition: developing the creative potential of the individual in the process of professional training, which is aimed at: predicting consequences, creative production of ideas; developing originality of thinking, flexibility, speed, thoroughness in finding solutions to problems; developing a creative approach to interaction, developing critical thinking;
- The third pedagogical condition – implementing training and a special course on the formation of creative competence to develop the creative potential of students, ensuring the influence of a creative educational environment.

Analysis of the effectiveness of the results of experimental work at the formative stage of the study.

At the formative stage (2023−2024), the developed pedagogical conditions for training university students to form creative competence in professional activity through the use of modern information technologies were implemented; monitoring of the implementation of pedagogical conditions, quantitative and qualitative analysis of results using mathematical statistics methods, formulation of research conclusions were carried out.

Let us present the results of the formative stage of the experiment

.

By motivational criterion (Fig. 1):

- In the EG, the number of people who showed a high level of creative motivation increased by 12%, and the number of students with a low level decreased by 26%.
- In the CG, there were no such significant changes: the number of respondents with a high level of creative motivation increased by only 0.9%, and the number of respondents with a low level of creative motivation decreased by 3%.

The changes that occurred after the implementation of the developed pedagogical conditions are shown by the analysis of the dynamics of the formation of the creative attitude of university students to the profession by the motivational criterion:

- In the EG, the dynamics of the formation of the creative attitude of university students to the profession by the motivational criterion increased at a high level by 10%, and the number of respondents who showed a low level decreased by 25%;
- In the CG, the percentage of high-level formation of creative attitude of university students to the profession by the motivational criterion increased by 2%, and the percentage of respondents with a low level of formation of creative attitude of university students to the profession by the motivational criterion decreased by 3%, which is significantly lower than the similar indicator in the EG.

The positive changes that occurred in the motivational criterion during the experimental study were the result of the introduction of the first pedagogical condition into the educational process.

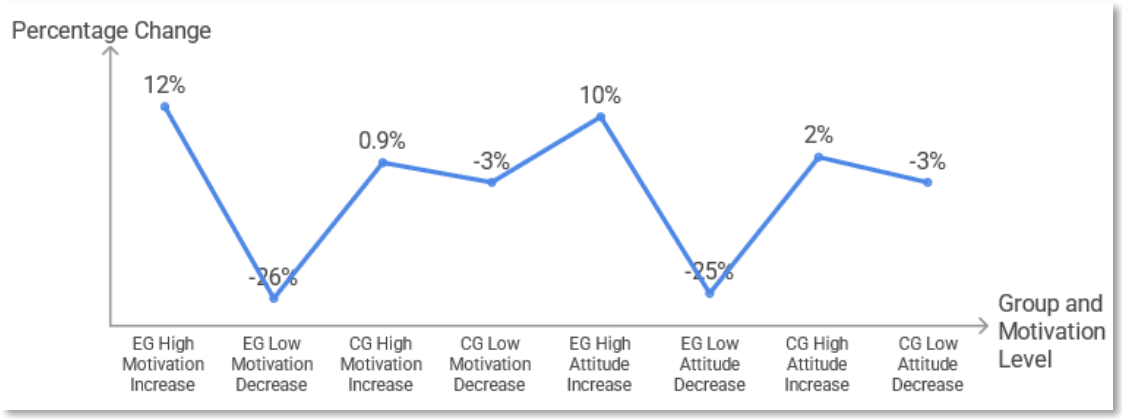

Fig. 1. Results of the formative stage of the experiment (by Motivation criterion).
By the personal criterion (Fig. 2).

Further diagnostics of the state of formation of creative competence in students by using modern information technologies took place according to the personal criterion.

In the personal criterion, the dynamics of changes occurred, which showed that:

- In the EG, the number of students with a high level of creative potential development increased by 9%, and the number of this same group of students whose level of creative potential development remained at a low level decreased by 20%;
- In the CG, the dynamics of a high level of creative potential development increased by 2%, and of a low level of creative potential development increased by 4%.
- In the CG, the number of students who showed a high level of reflection development increased by 10%, and the number of students who showed a low level decreased by 22%;
- In the CG, the percentage of high levels of reflection development in students increased insignificantly by 3%, and the number of respondents with a low level decreased by 7%, which is significantly less than the similar indicator in the EG.

During the experimental study, it was found that in the personal criterion, positive changes are caused by the introduction of two pedagogical conditions for the formation of creative competence into the educational process.

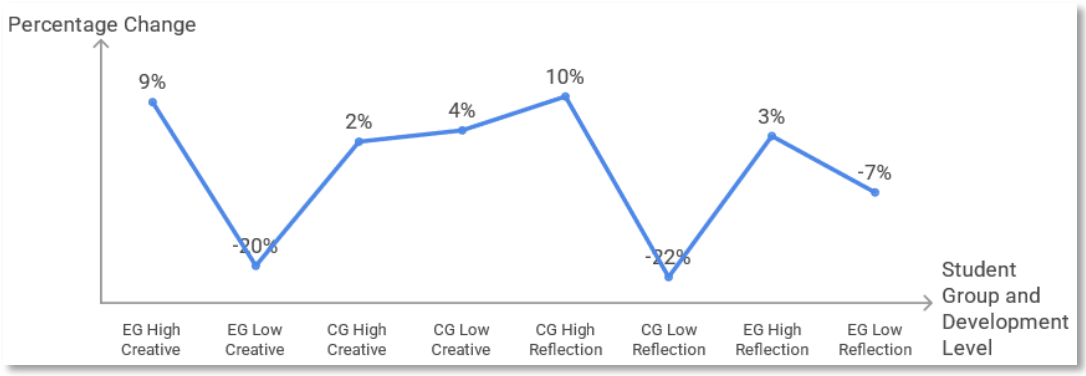

Fig. 2. Results of the formative stage of the experiment (by Personal criterion).
By the cognitive criterion.

In the course of the study, we will analyze the changes that occurred during the formation of the cognitive criterion indicators.

In the experimental group (Fig. 3):

1) The high level of divergent thinking development in students increased by 10%, and the number of respondents with a low level decreased by 18%;
2) The high level of associative thinking development in students increased by 7%, and the number of respondents with a low level decreased by 19%;
3) The high level of the behavioral creativity indicator increased by 9%, and the number of respondents with a low level decreased by 21%.

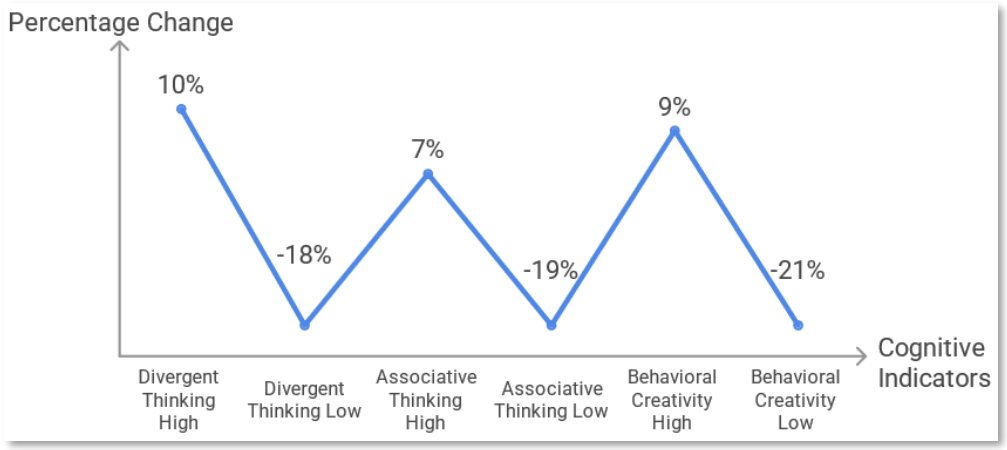

Fig. 3. Changes in cognitive criterion indicators (EG).

In the control group, the dynamics of changes in the cognitive criterion indicators did not become significant (Fig. 4):

- The high level of divergent thinking development in students increased by 2%, and the number of respondents with a low level decreased by 4%;
- The high level of development of associative thinking of students increased by 0.9%, and the number of respondents with a low level decreased by 3%;
- The high level, according to the indicator of creativity of behavior, increased by 2%, and the number of respondents with a low level decreased by 4%.

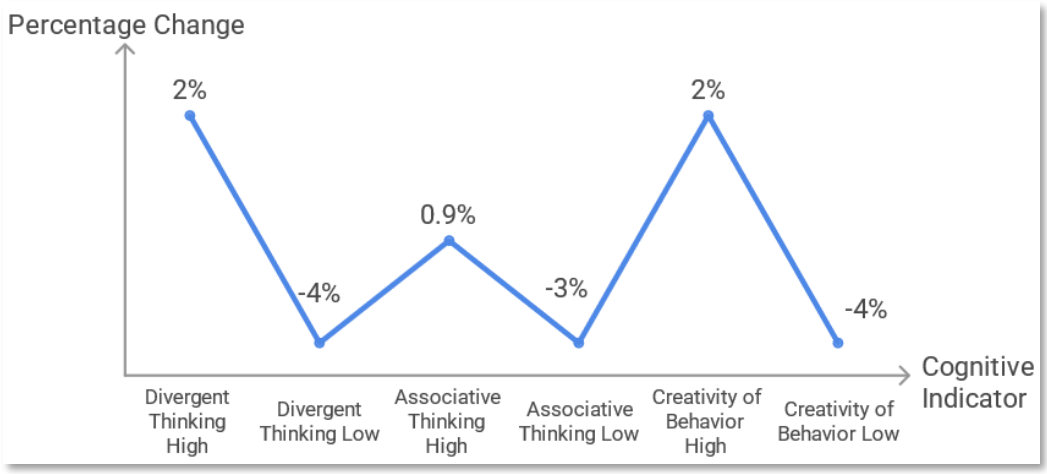

Fig. 4. Changes in cognitive criterion indicators (CG).

According to the indicators of the cognitive criterion, we observe the general dynamics of changes (Fig. 5):

- The number of EG students at a high level of knowledge effectiveness increased by 16%, and the number of respondents whose level of knowledge effectiveness remained at a low level decreased by 30%;
- Respectively, 3% and 6% of CG students observe the dynamics of high and low levels of their knowledge effectiveness.

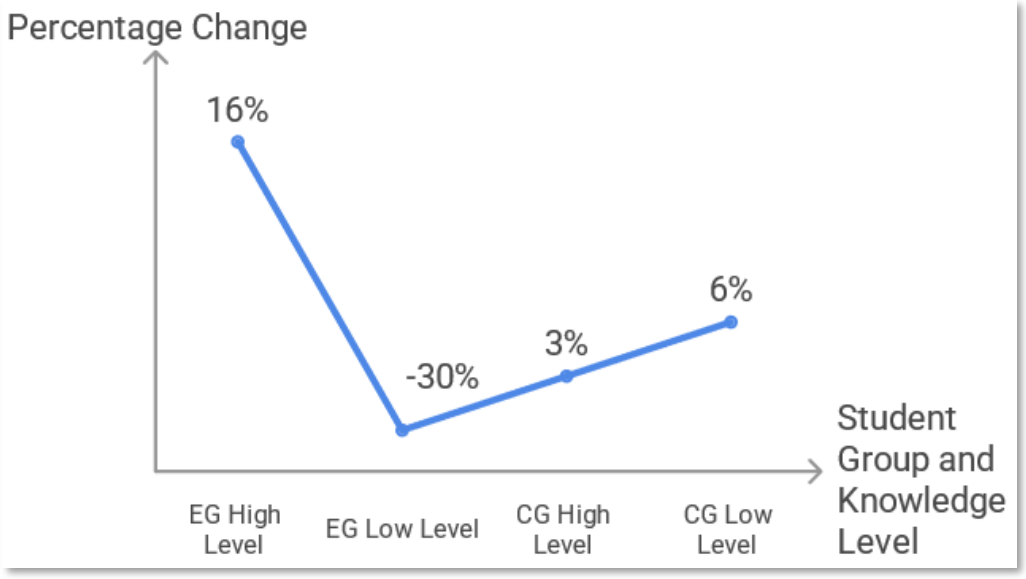

Fig. 5. General dynamics of changes (by the cognitive criterion).

Thus, according to all the specified criteria and indicators, a positive dynamic of creative competence was formed through the use of modern information technologies in EG students, which confirms the significant influence of certain pedagogical conditions on the preparation of students for the manifestation of creative competence in professional activity.

The results of mathematical statistics confirmed the study of the effectiveness of the implementation of the developed pedagogical conditions for training students of socio-economic specialties to identify creative competence in professional activity.

The null hypothesis was formulated: the distribution under consideration corresponds to the normal law. Alternative hypothesis: the distribution under consideration does not correspond to the normal law. All hypotheses are tested with a confidence probability of 0.95, that is, with a risk of 5%.

After the implementation of the pedagogical conditions developed by us for training students to form creative competence in professional activity through the use of modern information technologies, the arithmetic mean increased in all indicators of the identified components of creative competence in the EG, and the CG the changes were insignificant (unlike the control group, the percentage of respondents with high levels of indicators increased in the experimental group). This indicates the effectiveness of the pedagogical conditions that have been experimentally tested.

Statistical analysis methods were used to distinguish random fluctuations from significant changes.

Using the Student's t-test statistics, the change in the difference between the two mean values was analyzed. The hypothesis about the normal distribution is accepted for all four criteria of indicators, and we can use the Student's t-test.

For EG and CG, we formulate the hypotheses: null and alternative.

H0 – the null hypothesis is that: the difference in the mean indicators of the experimental (control) group – two sets of objects is insignificant for k = N1 + +N2 – 2 degrees of freedom before and after the application

of the methods, i.e. the high level of formation of creative competence in EG respondents is explained by random factors.

H1 – alternative hypothesis is that: the difference between the average indicators of the experimental (control) group – two sets of objects is significant for k = N1 + N2 – 2 degrees of freedom before and after the application of the methods, that is, it is the introduction of pedagogical conditions that proves the high level of formation of creative competence in students in EG.

H0 – the null hypothesis is accepted, that is, for all criteria of indicators, the mathematical expectations of EG and CG do not have a statistical difference. That is, the indicators of students of both groups, EG and CG, before the experiment are statistically the same.

We find – all indicators are greater than the critical value. We conclude that the difference between the average values of the levels of formation of creative competence in university students through the use of modern information technologies in the experimental group is statistically significant. And the difference between the contingent of the experimental group before and after the implementation of the methods, that is, between the two populations, is significant and not accidental.

This fact is the basis for accepting the alternative hypothesis for the experimental group and rejecting the null hypothesis.

Comparison after the experiment of the indicators of CG and EG students suggests that they differ significantly. We argue that experimental training is successful, and these positive changes occurred thanks to it, given that after the experiment, EG students have higher average indicators.

Let us describe the consideration of the change in the distribution frequencies after the experiment. The statistical hypothesis that we are testing is “EG and CG have the same probability distribution” and the alternative: “EG and CG have different probability distributions”.

We used the Pearson consistency criterion (dichotomous criterion), comparing the relative frequency of the control group, which has a “high level”, only the relative frequency of the experimental group, which has a “high level”.

We determine the relative frequency of participants who have a high level in all indicators. We calculate the empirical value of Fisher’s criteria. As a result, we obtain 0.722. We compare the empirical value of 0.722 with the critical value of the statistic 1.64. Thus, we accept the null hypothesis − H0. There is no difference before the experiment between the two statistical distributions of the two groups (EG and CG) of the relative frequencies of the number of students with “high level” indicators. This means that before the experiment, both groups (EG and CG) did not differ statistically in the considered indicators. Similarly, we continue the calculations for respondents with average and low-level indicators.

As a result, we obtain the measurable value of Fisher's criterion for low and high levels of the experimental group more than the critical tabular value, 247, that is, the creative competence of students after the experiment in EG is statistically significant and has changed positively (the share of low level has decreased statistically significantly, and the share of high level has increased statistically significantly). For low and high levels of the control group, we obtain a less critical tabular value of Fisher's criterion. Thus, the creative competence of respondents in the control group has not changed significantly.

Therefore, we can conclude that the results obtained are statistically significant.

In order to compare the differences between the groups before and after the introduction of a special course in the EG, which was aimed at developing creative competence in university students for the practical

mastering of creative practices using information technologies, the following statistical analysis was used: Student's t-test and Fisher's exact test.

The Student's t-test and Fisher's exact test are statistical tests that we used to compare the groups – EG and CG. Student's t-test was used to compare the mean values between the groups, and Fisher's exact test was used to compare the difference (dispersion) between the groups.

Comparing the mean values of two samples is one of the tasks in our study of the verified phenomenon of EG and CG. We solved this problem using Student's t-test (t-test). In particular, the null hypothesis is tested, which is that in the EG and CG both samples from the same general population were formed, that is, the differences are not caused by the action of the studied factor and are random between the mean values of the compared samples. The Student test belongs to the group of parametric analysis methods, therefore its correct application required the fulfillment of the following three conditions:

- Both samples must be independent (the properties of one of the samples must not be related to the properties of the other sample);
- Both samples must have a normal distribution law or one close to it;
- Homogeneity of variances (there must be no statistically significant difference between the dispersions of the samples).

Let us show the procedure for checking the significance of the coefficient by Student's t-statistics:

1. We choose the significance level of 1 or 5%.
2. We calculate the number of degrees of freedom.
3. Determine the critical value t for a, n – k, where k = m + 1, and m is the number of factors according to the Student distribution table. The critical value of the Student t-statistic was chosen for a = 0.05 and γ =(n – 2) = 16 – 2 = 14 degrees of freedom. 2.145 − is equal to its value.

The calculated value of the t-statistic in absolute value is greater than the table value, therefore the correlation coefficient calculated for the selected significance level is significant for us.

We used Fisher's test in the study, because the test statistic of this criterion when performed is reduced to the ratio (sums of squares divided by "degrees of freedom") of the sample variances. The denominator and numerator were independent random variables, and the corresponding sums of squares had a Chi-square distribution. The statistic had a Fisher distribution, because our data had a normal distribution. In addition, the variance of the random variables whose squares are summed is the same. At a given significance level, a test was performed by comparing the value of the statistic with the critical value of the corresponding Fisher distribution.

Using the p-value − p(F), a convenient way to test hypotheses, the probability that, with a given Fisher distribution, a random variable will exceed a given value of the statistic. We assumed that if p(F) (for a two-sided test − 2p(F) is less than the significance level α, then the null hypothesis is rejected, and otherwise this hypothesis is accepted. When testing hypotheses, two cases of sample variances are possible: the variances are unequal or equal. In this regard, we had the task of testing the hypothesis of the significance of two variances – their differences. In general populations, to test the hypothesis of the equality of two variances, we used Fisher's exact test, which is based on two sample adjusted variances, their ratio, which in general populations replace the values of the variances. Using special tables, we found the critical values of Fisher's exact test for the corresponding number of degrees of freedom and a given significance level.

Scientific novelty of the study.

Comparing the results of various literary sources, the scientific novelty of our article is that we have for the first time identified and theoretically substantiated organizational and pedagogical conditions that positively affect the formation of creative competence in professional activities using information technologies

(motivation and stimulation of the value attitude of future digital technology specialists to the formation of creative competence; taking into account the educational aspects of using network services based on information technologies.

Practical significance of the study.

The practical significance of the study lies in the practical implementation of organizational and pedagogical conditions of creative competence in professional activities using information technologies and the implementation of a special course aimed at the development of creative competence in university students for the practical mastery of creative practices using information technologies that form individual technologies and socially oriented technologies in the development of a student's creative competence.

Conclusions

The content of the concept and the main indicators of creative competence are revealed; the qualities that are highlighted in the structure of the creative competence of the individual are highlighted; the creative abilities of the individual are analyzed, the properties inherent in the creative personality are determined and the criteria are identified to assess the individual's ability to creative thinking, informatization of knowledge, and innovative personality traits.

In order to verify the pedagogical conditions developed by us and substantiated for preparing students for the formation of creative competence in professional activity through the use of modern information technologies, we organized a pedagogical experiment that included the stages traditional for pedagogical research: ascertaining and formative. The experiment took place in the natural conditions of the university educational process.

The following components were identified in the structure of students' creative competence: motivational, cognitive, activity, and reflective.

We determined the criteria and indicators of the formation of students' creative competence through the use of modern information technologies and readiness to reveal creative competence in their future professional activities, during the study.

We determined three levels of assessment of the formation of students' creative competence for each criterion: high, medium, and low.

The results of mathematical statistics confirmed the study of the effectiveness of the implementation of the developed pedagogical conditions for the preparation of students of socionomic specialties for the identification of creative competence in professional activity.

Limitations of the study. The implementation of the pedagogical experiment was carried out in three stages during 2024-2025: preparatory, main and final.

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 120 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 informational influence and were divided into a control group (60 students) and an experimental group (60 students).

The research was implemented through the use of 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, their simultaneous use in the information space; mobile devices, personal computers, web-based resources that are freely available and free of charge (YouTube, author's website, specialized sites, social networks, social network technologies), etc. The limitations of this study allowed to have the following impact on the results: improved quality characteristics of the material, optimally specified goals and objectives, increased effectiveness of the results.

Future research directions. The issue of organizing the international activities of a modern university requires further study, 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 in the development of creative competence in students, analyzing the long-term consequences of the use of virtual simulations, and developing approaches to improving social and communicative skills in combination with innovative teaching tools.

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