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ARTIFICIAL INTELLIGENCE: A TOOL FOR QUALITY TRAINING OF FUTURE SPECIALISTS IN SOCIO-ECONOMIC SPECIALTIES

INTELIGENCIA ARTIFICIAL: UNA HERRAMIENTA PARA LA FORMACIÓN DE CALIDAD DE FUTUROS ESPECIALISTAS EN ESPECIALIDADES SOCIOECONÓMICAS

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ABSTRACT

The article analyzes the content and main tasks of research and innovation activities of socionomic specialists. The factors that contribute to the increasing efficiency of work in science and education through computer technologies and artificial intelligence are identified. The role of independent research and innovation activities for future specialists in socionomic disciplines in higher education is demonstrated, as is the role of computer technologies and artificial intelligence in the professional training of specialists in research and innovation. The development of research competence among future specialists in socionomic disciplines, grounded in foundational research skills, is essential in the educational process. Using the parametric criterion (t-normal distribution criterion), the results of statistical data processing obtained in this subsection, and the nonparametric criterion (Fisher's angular transformation ϕ*), the effectiveness of the developed pedagogical conditions for forming the readiness of future specialists in socionomic specialties for research and innovation activities and the effectiveness of the proposed methods, forms, and means implemented within the framework of the innovative system for training future specialists in socionomic specialties for research and innovation activities using computer technologies and artificial intelligence in the process of professional training of specialists were confirmed.

Keywords:

Research and innovation activities, Artificial Intelligence, Computer technologies, Information resources, Future specialists in socio-economic specialties, Research skills.

RESUMEN

El artículo analiza el contenido y las principales tareas de las actividades de investigación e innovación de los especialistas en socionomía. Se identifican los factores que aumentan la eficiencia del trabajo en ciencia y educación mediante las tecnologías informáticas y la inteligencia artificial. Se muestra el papel de las actividades independientes de investigación e innovación para los futuros especialistas en socionomía en la educación superior, así como el de las tecnologías informáticas y la Inteligencia Artificial en el proceso de formación profesional de dichos especialistas. La formación de la competencia investigadora en los futuros especialistas en socionomía, determinada por las habilidades básicas de investigación, es importante en el proceso educativo. Utilizando el criterio paramétrico (criterio de distribución t-normal), los resultados del procesamiento estadístico de datos obtenidos en esta subsección y el criterio no paramétrico (transformación angular de Fisher ϕ*), se confirmó la eficacia de las condiciones pedagógicas desarrolladas para la preparación de los futuros especialistas en socionomía para las actividades de investigación e innovación, así como la eficacia de los métodos, formas y medios propuestos, implementados en el marco del sistema innovador de formación de futuros especialistas en socionomía para actividades de investigación e innovación utilizando tecnologías informáticas e Inteligencia Artificial en el proceso de formación profesional de especialistas.

Palabras clave:

Actividades de investigación e innovación, Inteligencia Artificial, Tecnologías informáticas, Recursos de información, Futuros especialistas en especialidades socioeconómicas, Habilidades de investigación.

INTRODUCTION

Radical changes in the social life of each individual, as well as in modern politics, economics, and ecology, are due to scientific and technological progress. This has led to a steady increase in the training of scientific personnel and to their growing importance to the scientific field, promising young people to society. An integral part of the educational process in higher education is scientific activity using information technologies, which is carried out within the higher education system to integrate educational, scientific, and productive activities (Chyrva, 2022). One tool for improving the quality of professional training for specialists in modern education and digital skill development is the use of Artificial Intelligence (AI).

Therefore, the main objective of modern education is to train specialists in socioeconomic fields for research and innovation activities using Artificial Intelligence (AI) and information technologies. In professional practice, these specialists possess specific skills in scientific research, integrative knowledge, and the ability to work according to the model and logic of scientific research, which involves the design, forecasting, and construction of experiments.

Literature review

An analysis of recent publications and research from the scientific community reveals significant interest in various theoretical and methodological principles of student training in higher education and in the training of scientific and pedagogical personnel: substantive principles for implementing the research component in the training of specialists in socioeconomic fields for research and innovation activities; and the generalization of practical experience in higher education in creating technological and organizational conditions through information technologies for developing research skills in future specialists (Bezliudnyi et al., 2022).

Dolynyuk & Shuper (2024) analyzed the possibilities of using Artificial Intelligence to improve the quality of professional training in mathematics teaching for future primary school teachers. They described directions for its application in distance learning for graduates. They presented examples of pedagogical tasks on specific topics within the disciplines “Fundamentals of Primary Mathematics” and “Methodology of Teaching the Mathematics Educational Branch.” The theoretical and methodological principles of training specialists in management for research and innovation activities are described, based on Chyrva (2022). The author analyzes international documents that underscore the importance of training PhDs and scientific and pedagogical personnel in research and innovation worldwide. It is established that “the system for training PhDs for research and innovation activities requires the constant improvement of theoretical and methodological principles within the context of national standardization of the specified process, while preserving the autonomous rights of higher education institutions,” and scientific to the uniqueness of their educational and scientific programs.”

Tytarenko (2023) addresses this topic, aimed exclusively at technology teachers who use information technologies and the application of Artificial Intelligence (AI) in education. In particular, methods for training future specialists and the importance of the principles of scientific and research activities in the educational process are considered. Attention is paid to the development of critical thinking, the importance of forming a scientific awareness, and the ability to apply knowledge innovatively in practice. Modern and innovative approaches to integrating scientific research into higher education through information technologies are analyzed, including student participation in real research projects and the use of interactive, active

teaching methods that foster the development of research skills. In today's dynamic technological and information environment, the importance of applying scientific and research principles in the educational process for training future technology teachers is emphasized to develop the necessary competencies. The role of interactive and active learning methods for higher education students to acquire A deep understanding of scientific concepts is emphasized, as is the importance of the practical application of research knowledge. The role of independent research is highlighted.

Polishchuk (2018) studies the professional training of social workers for scientific and research activities using information technologies and artificial intelligence. He argues that scientific and research activities involve the application of a set of research skills and the development of a body of knowledge among social work specialists for conducting and organizing scientific research, and that these activities are a key aspect of social practice. In the research and innovation process for future social workers, the researcher defined the concept of preparing social workers for research and innovation and demonstrated the characteristics of applying a competency-based approach. Implementing this approach entails changes to the organizational design of the research and innovation process, particularly in how students acquire knowledge, set objectives, and use learning methods and skills specific to scientific and research activities involving information technologies.

Krasnova et al. (2020) analyze the use of forms and methods for preparing students for scientific and research activities in the context of distance education. In particular, based on an analysis of experience, they describe the forms and methods for organizing student scientific activities in relation to the problem of organizing scientific and research activities on electronic platforms. They reveal methods that contribute to the dynamism of student scientific and research activities.

Kniazian (2007) analyzed foreign experiences on the organization of student research and innovation activities. He presents innovative types of independent research activities (working with prepared questions, writing an ethnic autobiography, preparing portfolios, reports, essays, creating projects, organizing public presentations and authentic discussions, and using case studies), which ensure the systematic development of reflective and research skills and the systematic assimilation of professional knowledge by future specialists. Attention is paid to the systemic connection between practice and theory, the development of the student's own stance, critical judgment during independent research activities, interaction, debate, and creative forms that reflect the student's experience and personal perspective. Ways to establish collaborative relationships and lifelong self-directed learning are shown, both within the student group and between students and teachers.

Nosko & Mehed (2022) define the characteristics, essence, and central aspects of student research and innovation activities, using Artificial Intelligence and Information and Communication Technologies (ICTs) as integral to socio-pedagogical teaching. The theoretical principles of training future teachers for research and innovation are established; a key factor in the professional training system for future teachers for socio-pedagogical activity is identified: the organization of research and innovation. Analysis of recent publications and research from the scientific community reveals significant interest in various theoretical and methodological principles for training higher education students and for training scientific and pedagogical personnel: substantive principles for implementing the research component in the training of specialists in socioeconomic fields for research and innovation activities; consideration of methods for integrating future specialists into the educational process and the importance of the principles of research and innovation activities; generalization of practical experience in higher education in creating technological and organizational conditions for developing research skills in future specialists and the role of independent research; and analysis of foreign experience in organizing student research and innovation activities. However, the innovative approach to training future specialists in socioeconomic fields for research and innovation activities using information technologies and artificial intelligence has not been sufficiently studied.

To improve the training of future specialists in socioeconomic fields for research and innovation activities using information technologies and artificial intelligence.

METHODOLOGY

To achieve the study's objective, the following scientific methods were used:

- **Theoretical**: theoretical analysis of literary sources for the theoretical and methodological foundation and the definition of the study's conceptual and categorical framework; analysis and synthesis: to study national and international experience and the current state of development of the problem; content analysis of methodological materials to identify the main requirements for students' research and innovation activities; systematization and classification: to provide a foundation for research and innovation activities; structuring and modeling: to determine the criteria and levels of research and innovation activities;
- **Empirical**: diagnostic methods, questionnaires, analysis of activity outputs for component training, and

evaluation of the level of preparedness of future specialists for research and innovation activities using information technologies and artificial intelligence; pedagogical experiment to verify the effectiveness of the training system for future specialists in research and innovation activities.

- **Statistical methods**: parametric and non-parametric methods for statistical hypothesis testing to evaluate the relevance of the results of the pedagogical experiment. Visualization methods: to demonstrate the results of the experiment.

The study consisted of the following stages.

The first stage is theoretical. The state of the problem's development was examined in both theoretical and applied aspects, and the scientific literature on the subject was analyzed.

The second stage is experimental. The pedagogical conditions for training future specialists in socioeconomic fields for research and innovation activities using information technologies and Artificial Intelligence in educational activities were developed and theoretically substantiated; the stages of experiment verification and training were organized and carried out; and the experimental results were systematized.

The third stage is descriptive. This stage is dedicated to generalizing and analyzing the experimental and theoretical results of the research conducted, as well as to formulating conclusions.

The verification stage of the experiment included the following main tasks: the formation of a control group (CG) and an experimental group (EG); the determination of the initial level of preparation of future specialists in socioeconomic fields for research and innovation activities using information technologies; It was demonstrated at the beginning of the experiment that there are no significant differences in the level of preparation indicated between the GE and the GC.

We conducted a comparative pedagogical experiment as part of the research process, using a parallel structure. Its essence lies in the formation of two groups:

- An experimental group, in which active influencing factors were used.
- A control group, in which no active influencing factors were used.

In this case, two objects are compared and observed before and after the experiment.

To assess the preparedness of future specialists in socioeconomic fields for research and innovation activities, and the individual components thereof, a system of preparedness levels and criteria was developed, along with indicators of preparedness for research and innovation activities, using information technologies and Artificial Intelligence in educational activities.

The assessment determined the low, medium, and high levels of preparedness of future specialists in socioeconomic fields for research and innovation activities, using the selected criteria and corresponding indicators.

To facilitate comparison of data obtained during the stages of experiment design and development, as well as the final results, the results of the initial assessment of the preparedness of future specialists in socioeconomic fields for research and innovation activities are presented below.

The objective of the formative stage of the experiment was to establish the pedagogical conditions and an innovative professional training system for future specialists in socioeconomic fields, with a focus on research and innovation activities using information technologies and Artificial Intelligence in educational settings. The study was conducted during the period 2022–2024. The experimental training encompassed the future specialists in socioeconomic fields within the experimental group. It extended to quasi-research and innovation activities, as well as the educational process of applicants to higher education.

During the formative stage of the experiment, a diagnostic assessment was conducted on the preparedness of future specialists in socioeconomic fields for research and innovation activities using information technologies and Artificial Intelligence in educational settings. This assessment included both participants in the pedagogical experiment (GE) and students without specialized training (GC).

The results of the evaluation of the overall level of preparedness for research and innovation activities among future specialists in socioeconomic fields, based on the comprehensive preparedness assessment, were analyzed.

In the verification phase of the experiment, the diagnostic assessment revealed a lack of participants with a high level of preparedness for research and innovation activities in both groups. 74% of respondents in the experimental group (EG) and 86% in the control group (CG) reported a medium level of preparedness, whereas 26% in the EG and 14% in the CG reported a low level of preparedness for the specified activity.

Following the training phase of the experiment, a significant number of future specialists in socioeconomic fields emerged with a high level of preparedness for research and innovation activities using information technologies and artificial intelligence in educational settings: 78% of respondents in the EG and 16% in the CG.

At the same time, the number of future specialists in socioeconomic fields with a medium level of preparedness was 20% in the EG and 79% in the CG. The low level of training in research and innovation among future specialists in socioeconomic fields during the control phase of the experiment persisted in both the experimental group (2% of respondents) and the control group (5%). We recommend using Fisher's angular transformation (Fisher's ϕ criterion, ϕ*) to select one of the hypotheses and to assess differences in the training and preparation levels of future specialists in socioeconomic fields for research and innovation, driven by the introduction of information technologies and the use of Artificial Intelligence in educational activities. Using the parametric criterion (t-normal distribution criterion), the results of the statistical processing of data and the non-parametric criterion (Fisher angular transformation ϕ*) confirmed the effectiveness of the pedagogical conditions developed for the preparation of future specialists in socio-economic specialties for research and innovation activities using computer technologies, as well as the effectiveness of the proposed methods, forms and means, implemented within the framework of the innovative system for the training of future specialists in socio-economic specialties for research and innovation activities using computer technologies and the use of Artificial Intelligence in educational activities.

RESULTS-DISCUSSION

Content and main objectives of the research and innovation activities of specialists in socioeconomic fields, the role of information technologies, and the use of Artificial Intelligence in educational activities. Factors by which information technologies and the use of Artificial Intelligence in educational activities increase the efficiency of work in science and education.

The issue of the research and innovation activities of socioeconomic specialists, and their participation in scientific research, remains relevant today, as reflected in modern society's demands for specialist competence, as evidenced by the development of higher education and the orientation of global educational policy toward science and technology centers. Scientific research is the process of solving a scientific task or problem. By research and innovation activity, we understand "a process and a special type of cognitive activity, during which new aspects and properties of the studied reality are revealed, and the result is scientific work" (Kuchai et al., 2017). One form of knowledge is scientific research, in which, through the application of specific scientific methods and means, an intentional and systematic study of objects is conducted (Knysh et al., 2024).

Research and innovation activities satisfy applicants with their working modalities, are an essential component of the training of a future researcher, offer appropriate educational and methodological advice and support, and are multifaceted: "They allow for the undertaking of original scientific research and include various types of research activities within the context of a higher education institution with an existing system of activities and a suitable scientific environment. The applicants' interests and intentions, opportunities to develop their individual educational paths, level of independence, and access to the resources of a higher education institution are determining factors. It is the research orientation that permeates the content of all academic disciplines and production practices" (Bezliudnyi et al., 2022). Modern scientists define research and innovation as "creative cognitive activity that takes place within the framework of scientific research and aims to reproduce existing information and obtain new information"; as "a complex activity designed to create, master, and disseminate new knowledge to solve natural and social problems, the results of which, depending on the level of processing of the new knowledge, are scientific and informational products (publications, reports, theses), scientific and innovative products (technologies, models, projects), or innovative products (goods and services)" (Menyailo, 2020).

Information technologies play a fundamental role in research and innovation activities. They facilitate the collection, storage, processing, and transmission of information through the computerization of the educational process.

Modern information technologies are based on:

- The ability to store information on computer media.
- The development of automation using computers and communication media for information processing (Mytnyk et al., 2024).

Through software and hardware complexes, information technologies are implemented, comprising personal computers with the necessary peripheral devices, integrated into global local area networks and equipped with modern software.

One tool for improving the quality of professional training for specialists in the context of modern learning and digital skills development is the use of Artificial Intelligence (AI) (Kuchai et al., 2022).

The use of information technologies and Artificial Intelligence in educational activities increases the automation of both educational processes and scientific research, thereby improving the educational process in higher education. Information technologies and the use of Artificial Intelligence in educational activities increase the efficiency of work in science and education due to factors such as:

- The increase in the volume of helpful information through the generalization of experience from scientific developments and the accumulation of typical solutions.
- The reduction in the complexity, cost, and development time of scientific and research work thereby improves specialists' work.
- The acceleration and simplification of the processes of information processing, storage, transmission, and presentation.
- The assurance of the quality, depth, and precision of problem-solving.
- The ability to analyze options for synthesizing objects, their significant number, and decision-making.
- The reduction and simplification of the time required for research analysis and results processing (Puhach et al., 2021).

Therefore, the combination of scientific and research activities, information technologies, and the use of Artificial Intelligence in educational activities is the primary means, within the context of European integration, of increasing learning efficiency. The use of information technologies and Artificial Intelligence in educational, scientific, and research activities reduces research time by enabling the search, storage, transfer, presentation, and editing of information.

Students continually improve their skills in working with information technologies and in using Artificial Intelligence in educational activities; during their studies, they delve deeper into searching for and analyzing the necessary information.

The use of information technologies and artificial intelligence by students in socioeconomic fields for research and innovation is quite limited. However, it is becoming a necessary component for a senior specialist in the modern information technology field.

The use of Artificial Intelligence in the educational process contributes to the development of students' digital literacy, innovation, and critical thinking. This allows them to effectively apply information and communication technologies in their work, creating interactive and stimulating learning environments (Plakhotnik et al., 2022).

The following details the main tasks of research activities undertaken by students in socioeconomic specialties who use information technologies and Artificial Intelligence in educational activities:

- Participation in national and international scientific project competitions and scholarship programs.
- Implementation and development of research projects.
- Submission of copyright certificate applications.
- Publication of scientific research results in peer-reviewed scientific journals, particularly those indexed in the international scientometric databases Web of Science and Scopus.
- Participation in international mobility programs.
- Creation of textbooks and teaching materials that take into account technological and scientific advances through information technologies.
- Implementation of scientific research results through the use of information technologies.
- Organic unity of educational content and scientific activity programs.
- Participation of students in the educational process in scientific research conducted at higher education institutions.
- Organization of scientific, methodological, and practical seminars, olympiads, conferences, competitions for coursework, research, diploma, and other work of the participants in the higher education educational process through computer technologies (Chyrva, 2022).

The training of future specialists in a competency-based approach takes on an active character. That is, the development of theoretical knowledge about research and innovation activities for specialists in socioeconomic fields, as well as research skills, is carried out through students' practical activities. Work is organized around research projects and collaborative activities, including conducting micro-research projects in groups. Information technologies, active learning methods, and various learning approaches are utilized. Interdisciplinary connections are implemented throughout the learning process. A creative and individualized educational path is constructed. The most important professional qualities of the future specialist are developed: creativity, independence, responsibility, initiative, and information literacy.

Artificial Intelligence can adapt the educational process to each student's needs, providing exercises and tasks to master the material while taking into account their individual learning trajectory. The widespread use of non-imitative methods in student research activities (discussion, problem-solving, heuristic conversation, exposition-provocation, etc.) and imitative methods (playful situations, business games, etc.) allows higher education students to engage in active cognitive activities, understand problems that arise in everyday life, develop an interest in their future profession, and cultivate responsibility and independence in decision-making.

The use of active learning methods in the training of future specialists in socioeconomic fields for research and innovation activities using information technologies contributes not only to the development of professional interest

and thinking, but also to the conscious acquisition of professional skills and knowledge, and to the development of the communication skills necessary for a modern specialist in practice.

In addition to traditional higher education, methods for future specialists in socioeconomic fields to acquire knowledge and skills for research and innovation actively utilize cloud technologies, distance learning, information resources, and various independent student activities, both in their free time and in the classroom. To develop research skills for working with Artificial Intelligence and critical thinking, creative activities actively encourage students to explore new technologies in education.

The role of independent research and innovation for future specialists in socioeconomic fields in higher education, utilizing information technologies and Artificial Intelligence in the professional training process.

The organization of independent research and innovation activities by students, using information technologies and Artificial Intelligence in the professional training of specialists, is of particular importance and constitutes one of the most important components of the educational process, its primary form, and a prerequisite for the development of the professional competence of specialists in socioeconomic fields.

The development of research skills and competencies occurs through the independent research undertaken by future specialists in the socioeconomic fields of higher education. This contributes to the assimilation, in their subsequent development, of an interest in creative work, methods of cognitive activity, and the ability to solve scientific and educational research problems. Independent work in the classroom, in training future specialists in socioeconomic fields for research and innovation activities, and the use of Artificial Intelligence in the professional training of specialists involve various types of creative, monitoring, and practical tasks. These tasks include analyzing educational and scientific literature; attending seminars; writing reports, summaries, and essays; working with diagnostic materials; organizing and conducting research; and developing and testing results using information technologies, among others. This form of independent work is organized directly during classes in a specific discipline (Biletska et al., 2021). Extracurricular independent work is carried out throughout the discipline's period of study (e.g., preparing reports, completing written assignments, writing summaries and synopses, conducting research projects) and is not subject to rigid rules. Independent work in the teaching process is multifunctional. By working independently, students not only thoroughly master the teaching material but also develop research skills, professional experience, and the ability to work with scientific and educational literature, as well as the capacity to make constructive and responsible decisions in various situations. Depending on the level of independence the future specialist in socioeconomic fields achieves, the teaching staff must offer the opportunity to choose among independent assignments of different types (creative, reproducible, heuristic). In its modern conception, the independent work of future specialists in socioeconomic fields should contribute to the development of relevant competencies and mastery of course content, enabled by the innovative use of information technologies (Polishchuk, 2018).

Let us describe the types of categories of scientific research:

- Fundamental research governs the interactions and behaviors of the basic structures of society, nature, and thought, independent of their specific use, and aims to elucidate the laws.
- Applied research involves identifying opportunities in the process of solving socio-practical and cognitive problems to apply the results of fundamental research (Nosko & Mehed, 2022).

A future specialist in socioeconomics must possess the skills necessary for independent, creative scientific and research work, master the scientific and methodological principles and standards of research and experimentation, have a broad range of scientific interests, understand the regulatory framework for the design and implementation of research results, and utilize Artificial Intelligence in their professional training.

Providing prospective students with the opportunity to participate in scientific laboratories, engage in real-world scientific and research projects that use computer technologies and artificial intelligence, and publish scientific articles in professional journals significantly contributes to their professional growth and enriches their experience. This opens new perspectives for students, attracting the most talented to a future scientific career.

Facilitating access to modern computing technologies, literature, and scientific databases is essential to supporting students' independent work and their deep immersion in their research topics.

The use of active and interactive teaching methods, as well as the application of Artificial Intelligence in the professional training of specialists, is a significant factor in enhancing students' professional development in research and innovation activities. This empowers aspiring professionals to be active participants in the educational process, rather than mere observers. The inclusion of university courses in curricula that focus on developing students' research skills in research and innovation activities, such as scientific communication, statistics, and scientific

research methods, is crucial for training future specialists in socioeconomic fields.

Student participation in real-world research projects also plays a vital role in developing the scientific and research competence of future specialists in socioeconomic fields. These projects encompass both practical and theoretical aspects of research. This allows future specialists in socioeconomic fields to broaden their knowledge and skills, gain valuable experience, and develop and realize their scientific potential. It is important to emphasize that preparing future specialists in socioeconomic fields for research and innovation involves continuous training, self-directed learning, critical thinking about innovations and scientific ideas, and not just mastery of scientific research methods. This requires higher education institutions to ensure access to modern scientific resources through the use of information technologies and Artificial Intelligence in professional training, the creation of a suitable information environment, and the promotion of students' active participation in scientific life. The task of the educational process is to prepare future specialists in socioeconomic fields not only as highly qualified specialists in their field but also as active participants in research and innovation activities, capable of implementing advanced information technologies and the use of Artificial Intelligence in the training process and in innovative thinking (Tytarenko, 2023).

In the educational process, it is important to develop the research competence of future specialists in socioeconomic fields, which is defined by basic research skills. To this end, future specialists need to master key skills and capabilities. Let us highlight the main ones:

1. Defining the objective and formulating the tasks of research and innovation activities (the primary skill is the ability to clearly formulate the objective, methodology, and tasks of independent research);
2. Formulating hypotheses (the ability to create well-founded and transparent hypotheses);
3. Logical skills (the help of logical skills developed in the analysis and substantiation of conclusions in research and innovation activities);
4. Working with and evaluating information (the ability to select what is necessary, and most importantly, to work with large amounts of information, evaluate its relevance to research and innovation activities, and determine its degree of reliability);
5. Selecting the necessary means and identifying ways to solve problems (developing skills to find effective ways to solve problems and identifying the tools necessary for their implementation);
6. The ability of future specialists in socioeconomic fields to solve problems creatively (possession of creative skills).
7. Planning professional activity (effective planning of the work process);
8. Conducting experiments using information technologies and recording the results of research and innovation activities (skills for the correct recording of research and innovation activity results and the conducting of experiments) (Kyrstia, 2025).

The integration of the identified competencies contributes to the development of a high level of research and innovation activity, as well as to the development of research competence, an important component of the future professional success of specialists in socioeconomic fields.

Organization and Methodology of Conducting a Pedagogical Experiment.

The study consisted of the following research stages.

The first stage is theoretical. The state of the problem's development was examined in both its theoretical and applied aspects, and the scientific sources on the topic were analyzed.

The second stage is experimental. The pedagogical conditions for training future specialists in socioeconomic fields for research and innovation activities using information technologies and Artificial Intelligence in the professional training process were developed and theoretically substantiated. The verification and training stages of the experiment were organized and conducted, and the experimental results were systematized.

The third stage is descriptive. This stage is dedicated to generalizing and analyzing the study's experimental and theoretical results, as well as to formulating conclusions.

The verification stage of the experiment included the following main tasks: the formation of a control group (CG) and an experimental group (EG); the determination of the initial level of preparation of future specialists in socioeconomic fields for research and innovation activities using information technologies; and the verification at the beginning of the experiment of the absence of significant differences in the indicated level of preparation between the EG and the CG.

We conducted a comparative pedagogical experiment in the research process with a parallel structure. Its essence lies in the formation of two groups:

- The experimental group, in which active influencing factors were used.
- The control group, where no active influencing factors were detected.

In this case, both groups were compared and observed before and after the experiment. To assess the preparedness of future specialists in socioeconomic fields for research and innovation activities using information technologies and artificial intelligence within their professional training, a system of preparedness levels and criteria, along with indicators for each component, was developed. The assessment identified low, medium, and high levels of preparedness among future specialists in socioeconomic fields for research and innovation activities using information technologies and artificial intelligence within their professional training. It was conducted in accordance with the identified criteria and corresponding indicators.

Positional criterion. Indicators: development of a value-based attitude in students towards research and innovation activities; stable motivation and development of willpower in future specialists in socioeconomic fields.

Cognitive criterion. Indicators: determination of the level of knowledge of future specialists in socioeconomic fields; mastery of the methodological and theoretical aspects of research and innovation activities; mastery of methods for disseminating computer innovations and for creating and developing computer and research projects; and the use of Artificial Intelligence in the professional training process of specialists; level of development of information, research, innovation, projective, communicative, and organizational skills and abilities; level of knowledge in the specialty.

Creative criterion. Indicators: mastery of the level of development of individual creative potential.

Reflective criterion. Indicators: level of awareness of one's own characteristics and of oneself as a subject of activity, actions, and skills; rethinking the results and the process of one's own activity using computer technologies; objectives; appropriate decision-making; and a need for constant self-improvement and personal development.

To facilitate comparison of the data obtained during the experiment's determination and formation stages, as well as the final results, the results of the primary diagnosis of the state of preparation of future specialists in socioeconomic specialties for research and innovation activities are presented below.

The objective of the training phase of the experiment was to introduce pedagogical conditions and an innovative professional training system for future specialists in socioeconomic fields, with a focus on research and innovation activities, utilizing information technologies and artificial intelligence in the specialist training process. The study was conducted during the period 2022–2024. The experimental training of students in the experimental group encompassed future specialists in socioeconomic fields. It extended to quasi-research and innovation activities, as well as to the educational process for higher education applicants.

The innovative professional training system for future specialists in socioeconomic fields for research and innovation activities using information technologies and artificial intelligence in the specialist training process included: the development of modern content for the training of future specialists in socioeconomic fields for research and innovation activities using information technologies and artificial intelligence in the specialist training process; and the creation of a research and innovation environment at the university using information technologies and artificial intelligence. The study ensured the integrity of the knowledge acquisition process for participants in the GE (Group Study), the use of modern learning methods and resources, the mastery of practical skills and abilities throughout the learning process, and the continuous updating of knowledge during the implementation of research and innovation activities. It also incorporated the use of Artificial Intelligence into professional training, integration, and educational activities through the acquisition of personal experience in implementing and developing innovation and research projects. Furthermore, it implemented a set of measures aimed at the professional development of specialists, self-reflection, the dissemination of research results at conferences, the promotion of research and innovation activities, and publication in scientific journals.

The study was based on socio-pedagogical training using information technologies and Artificial Intelligence in the professional training process for specialists. Following its completion, the prospective specialists in socioeconomic fields participated in reflection, research, and innovation activities. The main objective was to systematize and study the individual aspects of their professional preparation for research and innovation activities using information technologies and artificial intelligence in their professional training. Innovative and validated methods were proposed to study the inherent professional and personal qualities developed during university internships and laboratory work.

Great importance was placed on the independent work of the aspiring university students, and selected diagnostic methods were presented. In this way, the elements of scientific methodology, using information technologies and artificial intelligence, were mastered in the professional training process.

During the formative stage of the experiment, a diagnostic assessment was conducted of the preparedness of prospective specialists in socioeconomic fields for research and innovation activities involving information technologies and artificial intelligence, as part of their professional

training. Participants in the pedagogical experiment were assigned to the student group (GE), whereas students without specialized training were assigned to the student group (GC). By comparing the marginal values of the critical t-test and the calculated difference t-test, the probability of the difference between the two means was evaluated.

The absence of a significant difference between the compared means (i.e., $t < t_{crit}$) constitutes the null hypothesis (H_0).

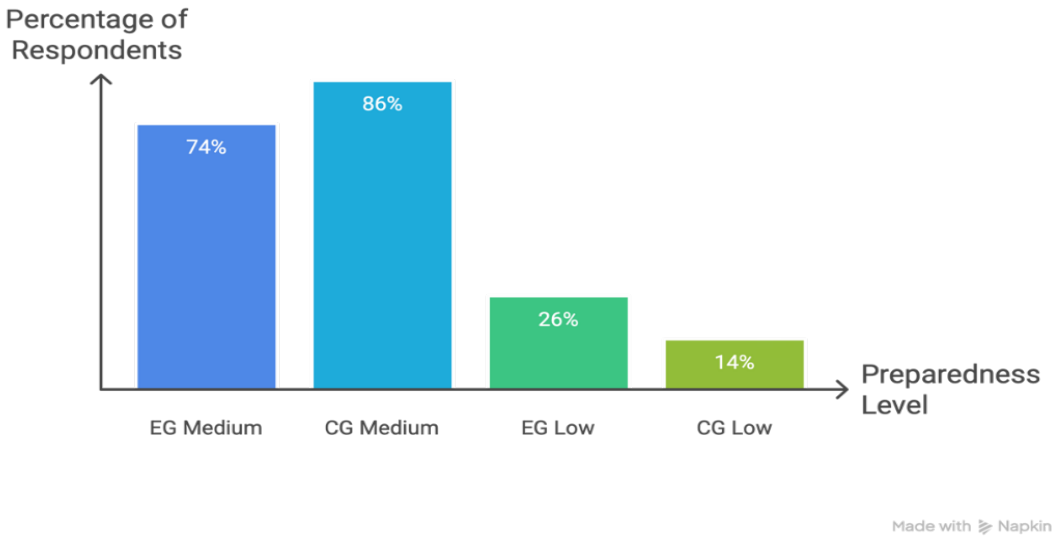
Under the condition that $t_{obs} > t_{crit}$, the alternative hypothesis (H_α) is rejected, indicating a significant difference between the compared values.

After the formative phase of the experiment, the statistical analysis of the data obtained according to the t-test allowed us to conclude that there are significant differences between the comprehensive evaluations of the preparation of future specialists in socioeconomic fields for research and innovation activities using information technologies and the use of Artificial Intelligence in the vocational training process in the control group (GC) and the experimental group (GE), given that $t_{obs} = 7.89$ was greater than $t_{crit} = 3.28$ with $p < 0.001$. This conclusion confirms the previously formulated alternative hypothesis (H_α) and demonstrates the effectiveness of the proposed measures within the implementation of the scientific-methodological training system.

We analyze the results of the overall preparedness assessment for research and innovation among future specialists in socioeconomic fields, based on the comprehensive preparedness index.

In the experiment's design phase, the assessments revealed a lack of respondents with a high level of preparedness for research and innovation activities in both groups. 74% of respondents in the experimental group (EG) and 86% in the control group (CG) showed a medium level of preparedness. In comparison, 26% of EG respondents and 14% of CG respondents showed low levels of preparedness for the specified activity (Figure 1).

Fig 1: Levels of Preparedness for Research and Innovation (The Determination Phase of the Experiment).



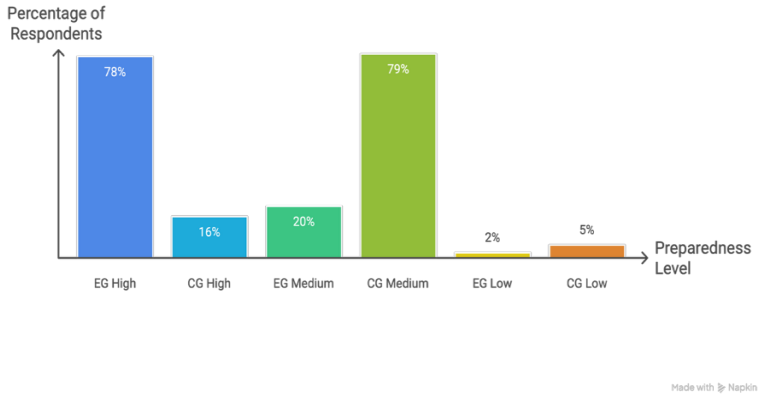
Source: Own elaboration

After the formative phase of the experiment (Figure 2), a substantial proportion of future specialists in socioeconomic fields demonstrated high levels of preparedness for research and innovation activities: 78% of respondents in the experimental group (EG) and 16% in the control group (CG).

At the same time, the number of future specialists in socioeconomic fields with a medium level of preparedness was 20% in the EG and 79% in the CG.

The low level of development of research and innovation activity among future specialists in socioeconomic fields persisted in the EG (2% of respondents) and the CG (5%) during the control phase of the experiment.

Fig 2: Levels of Preparation of Socionomic Specialists (The formative stage of the experiment)



Source: Own elaboration

We consider it advisable to use Fisher's angular transformation (Fisher's ϕ criterion, ϕ*) to select one of the hypotheses and to assess differences in the levels of development of the preparation of future specialists in socionomic fields for research and innovation.

The universality of Fisher's ϕ criterion, ϕ*, lies in the fact that the samples can be either related or independent, and the initial data can be measured on any scale. The criteria specified for solving problems of comparing levels of the studied characteristic can be applied to small sample sizes, characteristic shifts, and comparisons of distributions.

The universality of Fisher's ϕ test, ϕ*, allows us to verify differences in the proportions of samples in specific regions of the distributions, rather than only differences between the two distributions. The null and alternative hypotheses are formulated to verify the reliability of the results obtained.

The null hypothesis (H_0) assumes that the differences in the proportion of individuals with an adequate level of preparation for research and innovation between the compared samples are purely random and not systematic.

The alternative hypothesis (H_α), the opposite of the null hypothesis, assumes that the differences between the groups are statistically significant.

Therefore, using the parametric criterion (t-normal distribution criterion), the results of the statistical data processing obtained in this subsection, and the non-parametric criterion (Fisher's angular transformation ϕ*), confirmed the effectiveness of the pedagogical conditions developed for preparing future specialists in socioeconomic fields for research and innovation using information technologies and Artificial Intelligence in the professional training process, as well as the effectiveness of the proposed methods, forms, and resources implemented within the framework of the innovative training system for future specialists in socioeconomic fields for research and innovation.

CONCLUSIONS

This study analyzes the content and primary tasks of research and innovation activities undertaken by socionomics specialists. It demonstrates the role of independent research and innovation activities for future socionomics specialists in higher education, utilizing information technologies and Artificial Intelligence in the professional development process.

Developing research competence among future socionomics specialists, grounded on fundamental research skills, is crucial to the educational process. To achieve this, future specialists must master key skills and competencies. Therefore, this study identifies the main ones.

The systematic use of Artificial Intelligence (AI) in the professional development process for future specialists is an effective means of improving the quality and efficiency of education.

The implementation of pedagogical conditions and an innovative professional development system for future socionomics specialists has been developed and theoretically grounded. This system focuses on research and innovation

activities using information technologies and Artificial Intelligence in the professional development process. The experimental design and stages were organized and executed. The experimental results obtained were systematized.

A comparative pedagogical experiment was conducted as part of the research process, using a parallel structure. Its essence lies in the formation of two groups: an experimental group, in which active influencing factors were used; and a control group, in which no active influencing factors were present.

In this case, two objects were compared and observed before and after the experiment.

To assess the preparedness of future specialists in socioeconomic fields for research and innovation activities using information technologies and Artificial Intelligence in the professional training process, a system of preparation levels, criteria, and indicators was developed for each component.

The assessment determined the low, medium, and high levels of preparedness of future specialists in socioeconomic fields for research and innovation activities, using the selected criteria and corresponding indicators. To facilitate comparison of the data obtained during the determination and training phases of the experiment, the results of the initial assessment of the preparedness of future specialists in socioeconomic fields for research and innovation activities are presented alongside the final results. The objective of the training phase of the experiment was to introduce the pedagogical conditions and an innovative professional training system for future specialists in socioeconomic fields, destined for research and innovation activities, through the use of information technologies and artificial intelligence.

During the training phase of the experiment, a diagnostic assessment of the preparedness of future specialists in socioeconomic fields for research and innovation activities was conducted for participants in the pedagogical experiment (GE) and for students without specialized training (GC).

The results of the comprehensive preparedness assessment for future specialists in socioeconomic fields, based on calculations, were analyzed. Using the parametric criterion (t-normal distribution criterion), the results of the statistical data processing, and the non-parametric criterion (Fisher's angular transformation ϕ*) confirmed the effectiveness of the pedagogical conditions developed for preparing future specialists in socioeconomic fields for research and innovation, as well as the effectiveness of the proposed methods, forms, and resources implemented within the framework of the innovative training system for future specialists in socioeconomic fields for research and innovation through the use of information technologies and Artificial Intelligence in the professional training process.

Further research is needed to analyze modern and innovative approaches to integrating scientific research into higher education, including student participation in real research projects and the use of interactive and active learning methods that develop research skills.

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