Monograph

VOCATIONAL EDUCATION: VECTORS OF STRENGTHENING AND CHALLENGES OF THE PRESENT IN THE CONTEXT OF NATIONAL INTERESTS AND THE FORMATION OF AN EDUCATIONAL TRAJECTORY

Edited by
S. Stankevych, O. Mandych

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The monograph presented for review is a collection of research results on the development and regulation of professional education and vocational training, considering the tasks of educational management and agribusiness development. The authors include recognized experts and young scientists, providing a comprehensive analysis of psychological, pedagogical, and entomological aspects in the field. The research is conceptually grouped into sections: mechanisms of regulation of professional education, psychological and pedagogical discourse in professional training, modern problems and prospects of vocational education, and the entomological scientific school of Kharkiv National Agricultural University. The monograph will be valuable for researchers, educators, policymakers, postgraduate students, and all those interested in improving professional education and its role in agribusiness.

Keywords: professional education, management, economy, finance, vocational training, pedagogy, agribusiness development, entomology.

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THE MECHANISM OF REGULATION OF PROFESSIONAL EDUCATION AND TRAINING IN THE CONDITIONS OF FULFILLING THE TASKS OF EDUCATIONAL MANAGEMENT AND AGRIBUSINESS DEVELOPMENT

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1. The basics of scientific and pedagogical research and the mechanism of building general pedagogy

The modern stage of the development of pedagogical science is a period of significant changes and revision of scientific theories, as well as reorganization of basic conceptual ideas. One of the most important aspects is the changes in the interaction between science and society. To date, pedagogical pluralism has become the norm, corresponding to synergetics' provisions about the multivariate development. However, there are still traditional ideas about the role of pedagogical science, ways of its development, and methods of influence on pedagogical practice, which were formed back in Soviet times.

Among the factors that determine the effectiveness of pedagogical activity, the educational paradigm is in the first place, the system of work of the academic institution is in the second place, and the personality of the teacher is in the third place. This means that the current stage of the development of science requires conducting research within the framework of large topics aimed at creating new theories, substantiating integral educational systems, and the activity systems of individual educational institutions. In such conditions, the development of pedagogy and its impact on practice will be more effective.

Society goes through different stages of its development: rise, stable functioning, and crisis. Depending on the stage of development of society, the hierarchy of functions of pedagogical science changes. At the stage of stable functioning of society, the supporting function of pedagogical science becomes one of the leading ones. Education functions within a certain paradigm, and scientific activity is aimed at its further development and improvement, taking into account partial changes in the social environment.

Thus, scientific research at such stages of development is focused on improving existing pedagogical theories and deepening them.

Education is an important component of human culture, and its development is closely related to the development of pedagogical science. In turn, the development of education affects the general development of society's culture. The performance of the cultural function involves the introduction of the results of scientific research into the practical component of education.

The development of pedagogical science and the implementation of its functions largely depend on the training of scientific personnel. In Ukraine, this training is carried out according to ancient traditions and has stable forms.

In our opinion, the development of pedagogical science is evidenced by the following factors: a) emergence of new ideas and theories; b) expansion of research topics; c) differentiation of science and development of its branches; d) international recognition of her theoretical achievements; e) development of the conceptual apparatus of pedagogy; e) institutionalization of science; g) compliance of the development of science with its logic; g) development of various ways of solving pedagogical problems; h) availability of complex collective studies; i) development of pedagogical research technologies; i) close connection with the needs of practice; j) increasing the effectiveness of education; k) increasing the number of pedagogical publications, scientists and specialized dissertation defense councils.

Fifteen years ago, a systematic analysis of the state of development of domestic pedagogy was conducted according to the following criteria: emergence of new ideas and theories; expansion of research problems; differentiation of science and development of its branches; international recognition of theoretical achievements; development of the conceptual apparatus of pedagogy; institutionalization of science; compliance of the development of science with its logic; development of multivariate ways of solving pedagogical problems; availability of complex collective research; development of pedagogical research technologies; close connection with practice needs; increasing the effectiveness of education; increasing the number of pedagogical publications, scientists and specialized dissertation defense councils; optimal ratio of the process of differentiation and integration of scientific knowledge. The conducted analysis made it possible

to conclude that the current stage of the development of science should not be considered a crisis, but a turning point [1]. The further development of pedagogical science largely depends on the revision of the methodological foundations of its analysis and evaluation, as well as the improvement of management mechanisms and organizational forms of functioning.

The modern paradigm of Ukrainian pedagogical science is characterized by the following features:

• High level of institutionalization: the presence of the National Academy of Pedagogical Sciences (NAPS), a system of scientific research institutes, a state funding system, an extensive network of specialized councils for the defense of dissertations, formalized scientific degrees and titles, developed legislative and regulatory frameworks for the regulation of scientific activity, a developed system of training scientific personnel, a large number of scientists (mostly working in universities), numerous scientific publications and conferences [2].

• Absence of effective mechanisms for managing the focus of pedagogical research.

• Predominance of processes of differentiation over integration: the deepening of knowledge is accompanied by the loss of its integrity. Scientific research is carried out within scientific and pedagogical specialties with the corresponding specialized councils. The lost traditions of preparation of generalizing scientific works covering the results of individual specialties and pedagogical science in general. Even textbooks with the name "Pedagogy" are built according to old traditions and do not reflect modern theoretical and methodological principles.

• National isolation: research on comparative pedagogy, use of foreign sources and participation in international projects do not change the situation. The reasons are the insufficient level of knowledge of foreign languages among scientists and the tradition of organizing scientific activities.

• Insufficient level of development of pedagogical research methodology: the methodology is represented by few works on disciplinary methodology and methodology of separate dissertations. For example, dissertations on the history of pedagogy use research methods, which indicates insufficient development of this aspect.

• The dominance of the dissertation model of the functioning of science: the individual, disciplinary, and local nature of most scientific

research.

• Decreasing the prestige of scientific and scientific-pedagogical activity: the spread of false scientific morality, plagiarism, and demonstrative theses are frequent phenomena that do not cause effective social condemnation. This indicates insufficiently developed ethics of the scientific sphere.

• Ambiguity of the philosophical and general scientific foundations of pedagogical research: scientists declare different philosophical approaches (philosophy of instability, human-centeredness, synergetics, etc.), but the practice of education and scientific research is based on old or blurred foundations.

• Orientation of research on practice-oriented, technological, and experimental problems: Such research serves educational practice and provides situational knowledge relevant to a specific situation in a short time. This is positive only if it is linked to fundamental paradigmatic studies that provide forward and backward connections.

Reforming pedagogical science is impossible without changing its methodology. The nature of modern educational problems requires updating methodological approaches to their solution. Instead of global universal explanatory schemes (K. Marx's determinism, T. Parson's functionalism), a pluralistic methodology is coming, which offers "soft" methods that complement each other and are flexible, taking into account the socio-cultural features of the research object. In the postmodern era, a new ideal of science is being formed, based on the principles of interaction, evolution, mutual transformation, and self-organization of social systems. The theory and practice of the methodology of pedagogical science should be characterized by the following leading properties:

• Paradigmatic nature: focus on the study of large educational systems.

• Focus on interdisciplinary, interdisciplinary, integrative, and complex research.

• Prognostic and projective nature of research.

• Network, collective nature of research.

• Correspondence to educational realities, educational development trendsінандand, and international experience of educational research organization.

The objective nature of the methodology is determined by all the

previous properties. This distinguishes the new methodology from the current one, which is often insufficiently substantiated, individual-subjective, declarative, and demonstrative.

Further development of the methodology of pedagogy can be ensured through the creation of appropriate structural subdivisions in the National Academy of Sciences, systematic holding of scientific conferences on the methodology of pedagogical research, and organization of research on methodology problems. The need for further development of comparative pedagogy is due to rapid changes in the world and education in particular. Comparative pedagogy makes it possible to single out the leading trends in the development of education in the world and creates conditions for compliance of domestic education with these trends.

Due to the high level of institutionalization of pedagogical science and centralized management mechanisms, domestic comparative pedagogy can, under certain conditions, play a leading role in comparative education in the world and form a positive image of our science. For this, it is necessary to increase the scope and focus of research, increase the personnel and organizational potential of this field of pedagogy, as well as funding for research.

The system of higher education in Ukraine is being formed as one of the priority directions and value orientations of the state and public consciousness. The problems of upbringing, education, and development of the young generation are of particular importance since the future of humanity will largely depend on the development of the spiritual and moral sphere of society. Therefore, the professional pedagogical activity of a teacher as a bearer of spiritual values and an heir of generations is designed to promote the establishment of a humane, democratic personality capable of self-development and self-realization of their interests and talents.

The development of the higher education system requires the study and implementation of modern technologies and new methods of teaching children and youth from pedagogical science and practice. Innovations in pedagogy are related to general processes in society, globalization, and integration processes. Innovative activity in Ukraine is provided for by the Law of Ukraine "On priority areas of innovative activity in Ukraine for the period up to 2005" (2002), etc.

Professional pedagogy is a branch of pedagogical science that studies the regularities of professional growth, the content, forms, and

methods of training specialists in the system of primary, secondary, and higher professional education. The pedagogy of higher professional education is a part of professional pedagogy that examines the regularities of professional growth, the content, forms, and methods of training and professional development of specialists [3].

This education is aimed at training teachers with a high level of professional competence, which is based on the latest achievements of psychological and pedagogical sciences and modern special knowledge of a certain field of production. It also includes a high level of pedagogical competence, critical thinking, and the ability to apply scientific achievements in practice and implement the values of a democratic legal state [4].

Professional-pedagogical education should be humanistically oriented, that is, implement the ideas of humanism: ensuring the free comprehensive development of the individual, his abilities, needs, and interests (self-actualization of the individual); the orientation of the individual towards the conscious and responsible choice of self-important knowledge, behavior, actions in various life situations.

Pedagogical education is aimed at the formation of new life attitudes of the individual, the professional training of the modern generation of teachers, morally educated, who can independently make responsible decisions in a choice situation, predict their possible consequences, capable of cooperation, mobile, dynamic, constructive, with a developed sense of responsibility for the fate of the country and its young generation.

Modernization of the education system requires research into its innovation as a separate interdisciplinary field of scientific knowledge. Intensive development of innovative processes in modern conditions fundamentally changes the strategy of their management. A comprehensive understanding of the theory and practice of designing and implementing innovative processes involves revealing the main trends and contradictions in their development and formalizing the results of these studies in the form of laws, regularities, and principles.

The new philosophy of education and the new paradigm of education (in particular, state standards, and models of desired and planned results) require qualitatively higher professional training of a teacher-researcher capable of solving the task of cultural development of the

personality of a future specialist.

Professional and pedagogical education is a system of training pedagogical personnel (teachers, educators, etc.) for secondary schools and other educational institutions in pedagogical universities, institutes, colleges, and universities. In a broader sense, it is the training of pedagogical and scientific-pedagogical personnel for educational institutions of all types, including vocational and technical, secondary special, and higher educational institutions. It covers the totality of knowledge acquired as a result of such training.

Pedagogy is a science that represents a system of knowledge formed in the process of its historical development and characterizes the logic of the movement of scientific pedagogical thought. As a system, pedagogy has an internal structure, a certain structure, and interconnected elements and parts. The main sections of pedagogy include the general foundations of pedagogy (philosophy of upbringing and education), theory and methods of education, didactics, and school science. Pedagogical theory includes concepts, laws, regularities, ideas, principles, rules, means, methods, and forms of education and training [5].

Pedagogy, as a system, has an internal structure, certain interconnected elements and parts. The main sections of pedagogy include general foundations of pedagogy (philosophy of upbringing and education), theory and methodology of education, didactics and school science. Pedagogical theory covers concepts, laws, regularities, ideas, principles, rules, means, methods and forms of education and training. Important disciplines at this stage are those that create conditions for the development of key competencies, because pedagogy plays a system-forming role, ensuring the manifestation of these competencies in the context of professional pedagogical activity.

Modern educational activity should be based on the following basic principles:

• Correspondence of education to the needs of social and economic development of society.

• Ensuring the intellectual development of the individual, mastering effective methods of independent cognitive activity.

• Formation of young generations of high moral and spiritual qualities based on universal and national values.

• Development of a high environmental culture and responsibility

for environmental protection.

The features of each personality depend on the features of the human psyche, that is, its inner world, which consists of mental processes, qualities, states, and formations. All these aspects are the property of both the teacher and the student/listener, they appear and affect the course of the pedagogical process at the university.

The paradigm of the development of Ukrainian education in the 21st century, in particular higher education, is conditioned by the qualitative characteristics of the society of the future. Life requires an intellectually developed personality whose spiritual world is based on fundamental knowledge and the ability to self-educate in the context of ever-growing information.

The term "didactics" first appeared in the works of the German educator Wolfgang Rathke (1571–1635) and meant "the art of teaching." The English philosopher Francis Bacon (1561–1626) considered didactics an independent scientific branch, separating it from the system of philosophical knowledge. The Czech pedagogue Jan Amos Comenius (1592–1670), who called his main work "The Great Didactics", interpreted the term similarly. He defined the essence of didactics as "the universal art of teaching everything to everyone."

Initially, this term denoted practical activity, and over time it came to mean the science of integrally interrelated types of activity - teaching and learning. Didactics studies the substantive and procedural aspects of education in their unity: scientifically substantiates its content, methods and organizational forms, implementation conditions, special transformations and improvement of practice, looks for ways to improve, and develops new educational systems and technologies.

The main tasks of didactics include:

• Determination of the purpose and tasks of training, which is the basis of full-fledged training.

• Delineation of the content of education by the requirements of society, which allows the selection of scientific material and practical skills and abilities that students should learn.

• Identification of regularities in the learning process based on analysis special research and experimental work.

• Justification of the principles and rules of learning based on the revealed regularities.

• Creation of organizational forms, methods, and methods of teaching to acquaint teachers with methods of achieving the goals of the educational process.

• Provision of the educational and material base and learning tools necessary to fulfill the tasks of the learning process.

Didactics, as a part of pedagogy, has its categorical apparatus, including the categories of training and education. Restructured processes in society, the movement for the independence of states accelerated the process of school reform, which led to the emergence of new didactic theories.

2. Pedagogical technologies of teaching professional disciplines for students of professional education

The term "pedagogical technology" first appeared in education in 1886, when it was used by the Englishman James Sully (1842-1923). However, discussions regarding the existence of pedagogical technology as a certain tool of education and training continue until now. Now there are two principled positions. Proponents of one are convinced that education and training are creative processes, an intuitive understanding of the world of another person, and a corresponding influence on this world. Their opponents prove that the pedagogical process has an instrumental character, and its purpose is to educate a personality with predetermined properties.

The level of personal and professional development is the most important, basic characteristic of a specialist and is of decisive importance not only for a certain field but also for the entire society as a whole. The main task of education in higher educational institutions is the training of creative, highly educated specialists capable of working in various conditions, who strive for constant self-improvement and development and are competitive in the labor market. The training of such specialists requires that these qualities, first of all, be possessed by those who ensure the process of education and training. A teacher of a higher school mustn't be just a specialist in his field, but a person who constantly strives for professional self-development.

The main methods and pedagogical technologies of teaching professional disciplines for students of professional education are defined by us in Fig. 1.

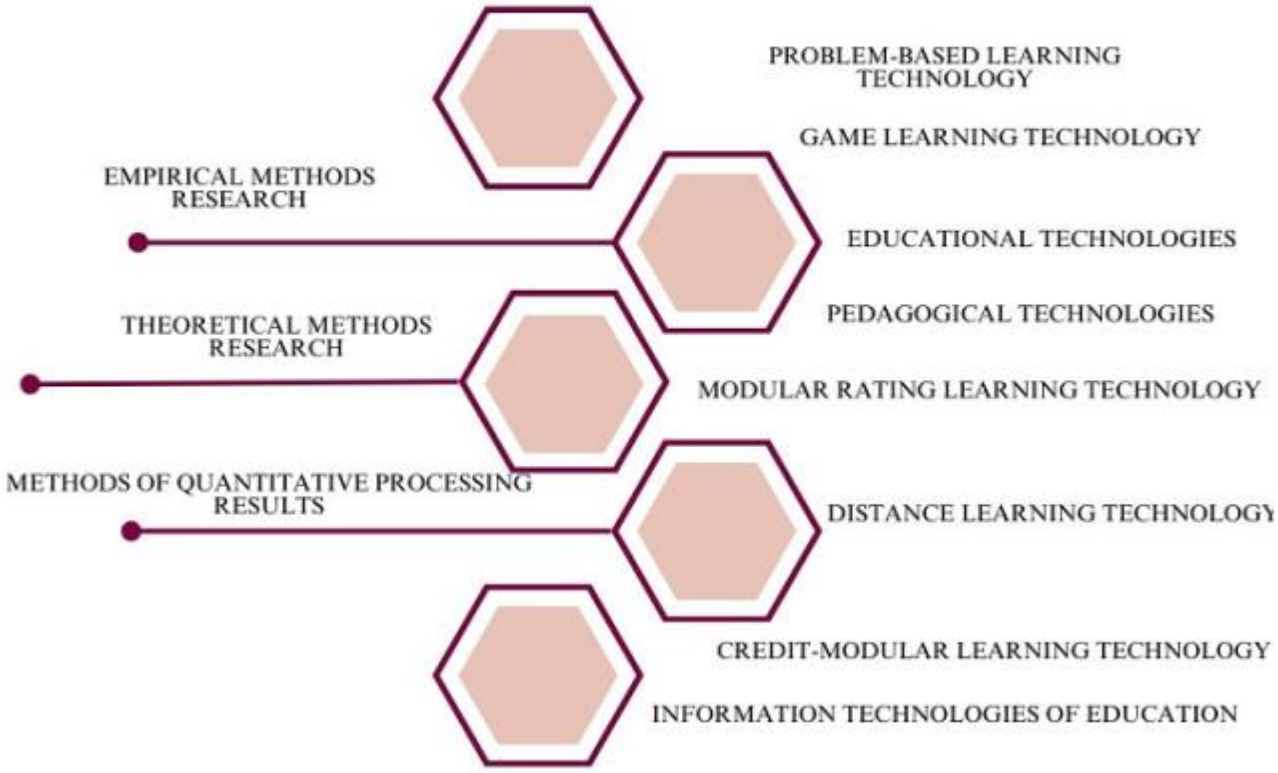

Fig. 1. Methods and pedagogical technologies of teaching professional disciplines for students of professional education

A high level of formed competencies, which is a guarantee of a person's successful professional activity, favors his favorable position in the socioeconomic sphere as a specialist, and therefore productive work, which is necessary for the cultural and economic development of the country in general. Therefore, a competent approach is necessary in professional education, the main task of which is the training of a qualified worker and a specialist in a certain branch or sphere of human activity He offers not just the transfer of knowledge, skills, and abilities from a teacher to a student, but the formation of professional competence. The importance of a competent approach is emphasized by M.V. Elkin, emphasizing that everyone in the professional sphere should use other categories - competencies, because the professional sphere operates with competencies, and the educated - with knowledge, skills, and abilities. He points out that if the professional sphere can meet its requirements for education exactly at the level of the order, then the task of education is to transform knowledge, skills, and abilities nor the competencies required by the professional sphere [7].

Scientific knowledge has always had a worthy place in university education. The presence of scientific schools in the structure of any university is an indicator of its activity, scientific achievements, and potential. However, a formal quantitative approach to this issue can nullify the essential idea of the activity of scientific schools, and their importance both for the preservation of scientific traditions and the creation of a new scientific product. In this context, the determination of the factors that influence the development of scientific schools and the criteria for their activity is quite relevant [14].

Modern universities are characterized by intensive innovation processes affecting the content and technologies of education. The innovative activity of agricultural universities is generated by the need to improve teaching, and the need to constantly update the content of educational courses. The main tasks of a teacher of professional disciplines are as follows: development and modification of training programs, preparation of training courses, textbooks, and additional training materials taking into account the constant development of the agricultural industry; conducting classes using innovative pedagogical technologies; stimulation of discussions for the development of independent thinking of students, organization and control over the performance of independent work by students by the personally oriented paradigm in education; writing scientific articles, participation in the work of conferences and seminars, management of scientific research works of students. The given list of tasks shows that a university teacher must possess the abilities of a researcher, organizer, orator, psychologist; to know the methodology of the organization of the educational process; to be a highly qualified specialist, both in his subject field, and an erudite in other fields of knowledge. Therefore, the transition from episodic professional development of teachers to their continuous education and continuous professional self-development is relevant for universities.

The spheres of influence and activity of subjects of pedagogical technologies are determined by various factors and needs, which determine the need to update and develop new pedagogical technologies. The process of development of a university teacher is quite complex and controversial but always has progressive characteristics aimed at increasing professionalism.

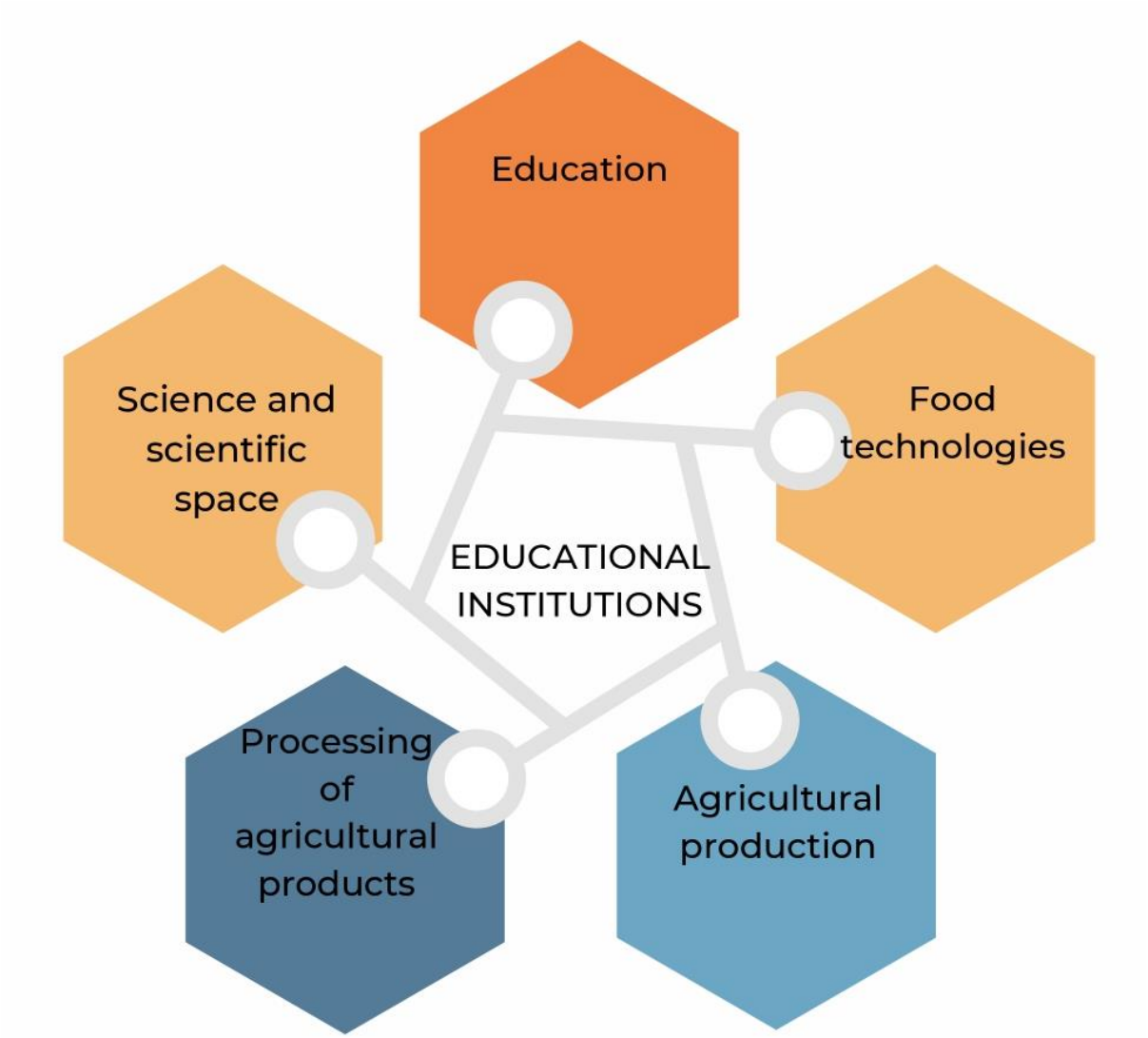

Fig. 2. Spheres of influence and activity of subjects of pedagogical technologies

Among the factors that actualized the urgency of updating existing and developing the latest pedagogical technologies, the following stand out:

1. National and economic needs of the state in preparing young people for life in new market conditions. This determines the education of students of certain qualities and the acquisition of certain skills:

o Think independently and critically.

o Adapt flexibly in changing life situations.

o Formulate problems and find ways to solve them rationally.

o Generate new ideas, and think creatively.

o Apply the acquired knowledge in everyday life.

o Develop gender education, gender awareness and gender culture.

o Be communicative, contact, able to work in a team and different social groups, prevent conflicts.

o Competently work with information from various sources: the Internet, literary and archival, periodicals, television, etc. This includes gathering facts, analyzing, hypothesizing, generalizing, comparing with alternatives, establishing statistical patterns, formulating reasoned conclusions, and using them to solve new problems.

o Developing skills of self-regulation of feelings and depressive states.

2. There is an urgent need to change the system of pedagogical violence in modern schools. It is necessary to create conditions for the development of personal potential of schoolchildren, preservation of their physical and mental health.

3. The need to introduce distance learning in professional and general educational institutions.

4. The need for the development of innovative learning and education technologies, including interactive methods (gaming, training, etc.).

5. The need to introduce innovative courses and special courses into the variable component of the educational content of pedagogical institutions.

The process of perceiving new ideas and innovations in the field of pedagogy is a complex multi-stage mental decision-making process, which has a long period from the first acquaintance of a person with an innovation to its final perception. According to the theory of innovation diffusion, developed by Everett Rogers, different segments of society have different inclinations to new things, which also affects the introduction of innovations in the pedagogical field.

The process of perceiving new ideas and innovations in pedagogical activity is a complex multi-stage process that includes evaluating the importance and consequences of decision-making. E. Rogers, who analyzed the spread of new ideas, goods, etc., identified the main stages of this process:

1. Stage of familiarization with the innovation: A person hears about the innovation for the first time, but is not yet ready to receive additional information.

2. Stage of emergence of interest: At this stage, a person begins to show interest in the innovation and searches for additional information about it. Information is not yet accompanied by motives of perception, that is, a person has not yet decided whether to "try on" an innovation for his problem. The main task at this stage is to get as much information as

possible about the innovation. Interest prompts a person to actively seek information, and situations determine where and how he will interpret it.

3. Evaluation stage: At this stage, a person mentally “fits” the innovation to their existing or projected situation and decides whether it is necessary to try this innovation. If a person believes that the positive features of the innovation outweigh the negative ones, he decides to try the innovation. This stage is not as clearly distinguished as the others, and due to its latency, it is the most difficult to empirically study. Most often, at this stage, a person is looking for specialized information, advice, and consultations regarding innovation.

4. Approbation stage: At this stage, the innovation is tested on a relatively small scale to decide whether it can be used to solve one's problems in a specific situation. The task of this stage is to determine the importance and weight of the innovation, while at the previous stage, a person only mentally played out a certain situation of introducing the innovation. At this stage, there is also a search for specialized information on the best methods of using innovations. The result of this stage can be both the unconditional acceptance of the innovation and its rejection.

5. Stage of final (final) perception: At this stage, a person makes a final decision about the perception of the innovation and its full use. The main task of this stage is to evaluate the results of the previous stage and make a final decision regarding the appl

These stages describe the gradual process of innovation adoption, which includes different levels of involvement and evaluation of a new idea or technology.

In his theory of innovation diffusion, Everett Rogers distinguishes five classes of people according to the degree of their adoption of new ideas and goods, while determining an approximate quantitative indicator for each class:

1. Innovators (2.5 % of the population). These are the most mobile people who have contacts outside their circle, easily accept ideas, even abstract ones, and are ready to take risks.

2. Early adopters (13.5 % of the population). These are respectable people, often thought leaders who influence those around them. People from this class are more attached to the local structure and are often a source of advice.

3. The early majority (34 % of the population). They accept new ideas

before they become widely accepted. Their information often comes from early adopters.

4. The late majority (34 % of the population). These are skeptics who accept innovations only after the majority of those around them have already made up their minds. They are less ready for change and need more time to accept new ideas.

5. Late adopters (16 % of the population). These are conservative people who adhere to traditional values and distrust everything new. Often they feel a lack of funds and adopt innovations as a last resort.

Rogers believed that the following are important for the successful implementation of innovations:

• Interpersonal communication at the level of people of the same circle and age.

• Ineffectiveness of patriotic appeals from government circles.

• Credibility of the source of communication.

• Mass media cannot change the behavior of people who hold a different point of view.

A change in attitude toward innovation in society usually occurs when 6 to 16 % of the population adopts it. This gives insight into how to introduce a new product into the mass consciousness.

The essence and main features of pedagogical technology

Pedagogical technology is a set of psychological and pedagogical attitudes that determine a special set and composition of forms, methods, ways, teaching techniques, and educational tools. It is an organizational and methodological toolkit of the pedagogical process (B. T. Lykhachev).

The concept of "pedagogical technology" can be represented by three aspects:

1. Scientific: Pedagogical technologies are a part of pedagogical science that studies and develops the goals, content, and methods of teaching, as well as designs pedagogical processes.

2. Procedural-descriptive: Description (algorithm) of the process, a set of goals, content, methods, and means to achieve the planned learning outcomes.

3. Procedural-effective: Implementation of technological (pedagogical) process, functioning of all personal, instrumental, and methodological pedagogical means.

Thus, pedagogical technology functions as a science that investigates

the most rational ways of learning, as a system of methods, principles, and regulators used in learning, and as a real learning process.

The main qualities of modern pedagogical technologies:

• Systematicity: completeness of the structure, logic of the process, interconnection of parts, integrity.

• Manageability: goal planning, process design, step-by-step diagnostics, variability of corrections.

• Effectiveness: guaranteeing the achievement of a certain standard of learning.

• Reproducibility: the possibility of application in other identical conditions.

Pedagogical technologies are maximally related to the educational process, including the activity of the teacher and student, its structure, means, methods, and forms. The structure of pedagogical technology includes:

The structure of pedagogical technology

1. Conceptual basis

2. Content part of training

o Learning goals (general and specific)

o Content of educational material

3. Procedural part (technological process)

o Organization of the educational process

o Methods and forms of educational activity of schoolchildren

o Methods and forms of teacher's work

o The teacher's activity in managing the process of assimilation of the material

o Diagnostics of the educational process

Criteria of manufacturability

Any pedagogical technology must meet the main methodological requirements (technological criteria):

Conceptuality

o Reliance on a scientific concept, which includes philosophical, psychological, didactic, and socio-pedagogical justification of the achievement of the educational goal.

Systematicity

o Process logic

o Interrelationship of all its parts

o Integrity

Controllability

o Possibility of diagnostic goal setting

o Planning, and designing the learning process

o Step-by-step diagnostics

o Variation of means and methods to correct the results

Efficiency

o Efficiency and cost-effectiveness

o Guarantee of achievement of a certain standard of education.

Reproducibility

o Possibility of application in other educational institutions of the same type by other subjects

Unity of substantive and procedural components of the educational system

In pedagogy, there is an idea of the unity of substantive and procedural components of the educational system: goals, content, methods, forms, and means of education. The components of pedagogical technologies show different degrees of conservatism:

• Most often, procedural aspects of training vary

• Content changes in structure, dosage, logic

• The content of education as an essential part of educational technology determines its procedural part

• Radical changes in methods invite deep transformations of goals, content, and forms

Textbooks

Between the procedural and substantive parts of the technology of education, there is an important didactic tool — the school textbook, which plays a key role in determining the content of education, the procedural part of the technology, and realizing their unity. In our country, a large number of variable textbooks have been created, which, together with the variety of pedagogical technologies, allows to improve the quality of education.

The role of performers

The same technology can be implemented by different performers more or less faithfully, exactly according to the instructions, or creatively. The personal component of the master, the specificity that characterizes the patterns of mastering the material, and the composition and sequence of students' actions affect the results, which will be different, but close to the

average value characteristic of this technology.

Sources and components of new pedagogical technologies

Any modern pedagogical technology is a synthesis of the achievements of pedagogical science and practice, a combination of traditional elements of experience and what was born of social progress, humanization, and democratization of society. Sources and components of pedagogical technologies include:

- Social transformations and new pedagogical thinking
- Science (pedagogical, psychological, social sciences)
- Advanced pedagogical experience
- experience (domestic and foreign)
- Folk pedagogy (Ethno pedagogy)

In the theory and practice of work of higher educational institutions (HEIs), there are many variants of the educational process, which can be classified according to various criteria. Pedagogical technologies reflect the individual approach of authors and performers, which makes each technology unique. However, they can be grouped by certain common features.

Classes of pedagogical technologies

1. By level of application:

o General pedagogical technologies: Cover the entire system of education and upbringing as a whole.

o Partially methodical (visual) technologies: Applied to certain aspects or elements of the educational process.

o Local (modular) technologies: Used to solve specific tasks within individual modules or topics.

2. According to the leading factor of mental development:

o Biogenic technologies: Focus attention on biological factors of personality development.

o Sociogenic technologies: Take into account the influence of the social environment on personality development.

o Psychogenic technologies: Focus on psychological features and processes of personality development.

o Idealistic technologies: The main attention is paid to the spiritual and ideological aspects of education.

3. Based on personal structures:

o Information technologies: Formation of knowledge, abilities, and

skills in subjects.

o Operational technologies: Formation of ways of mental actions.

o Emotional and artistic technologies: Formation of the sphere of aesthetic relations.

o Emotional and moral technologies: Formation of moral relations.

o Technologies of self-development: Formation of self-regulating mechanisms of the individual.

o Heuristic technologies: Development of creative abilities.

o Applied technologies: Formation of practical skills and abilities.

4. By nature of content and structure:

o Educational technologies: Oriented to the educational process.

o Educational technologies: Aimed at personal education.

o Secular and religious technologies: Take into account spiritual and worldview aspects.

o General educational and professional-oriented technologies: correspond to general educational or professional goals.

o Humanitarian and technocratic technologies: Focused on humanitarian or technical disciplines.

o Branch and partially subject technologies: Specialize in separate fields of knowledge or subjects.

o Monotechnologies: Built on one priority idea, principle or concept.

o Complex (polytechnologies): Combine elements of various monotechnologies.

o Penetrating technologies: They are integrated into various aspects of the educational process

Substantive provisions

1. Conceptuality and systematicity: Pedagogical technologies should be based on a scientific concept, including philosophical, psychological, didactic, and socio-pedagogical justification of educational goals.

2. Manageability and efficiency: The possibility of diagnostic goal setting, planning, designing the learning process, step-by-step diagnostics, and correction of results.

3. Reproducibility: Applicability of the technology in other educational institutions of the same type by other subjects.

4. Unity of substantive and procedural components: Goals, content, methods, forms, and means of education must be integrated and interdependent.

Thus, pedagogical technologies are complex systems that integrate various elements and aspects of the educational process to achieve maximum efficiency in the education and training of students.

Penetrating pedagogical technologies

Pervasive pedagogical technologies are those whose elements are often incorporated into other technologies, acting as catalysts and activators. Their use contributes to increasing the effectiveness of the educational process due to their integration into other technologies.

Classification of pedagogical systems (technologies) according to V.P. Bespalko

V.P. Bespalko proposed the classification of pedagogical systems by the type of organization and management of cognitive activity:

1. Classical lecture teaching: management is open, scattered, manual.

2. Training with the help of audiovisual technical means: management is open, distributed, and automated.

3. "consultant" system: management is open, directed, and manual.

4. Learning with the help of a textbook: management is open, directed, and automated (independent work).

5. The system of "small groups": management is cyclical, scattered, and manual (group, differentiated methods of learning).

6. Computer training: management is cyclical, distributed, automated.

7. "Tutor" system: cyclical, directed, manual control (individual training).

8. Program training: management is cyclical, directed, automated, and based on a pre-compiled program.

Combinations of mono-didactic systems

In practice, the most common combinations of these mono-didactic systems are:

• Traditional classical classroom system of Ya.A. Comenius: a combination of the lecture method of teaching and independent work with the book (discography).

• Modern traditional teaching: uses discography in combination with technical means.

• Group and differentiated learning methods: the teacher has the opportunity to exchange information with the group and pay attention to individual students as a tutor.

• Programmed learning: based on adaptive program management with

partial use of all other types.

Classification of pedagogical technologies according to the nature of the content and structure

1. Educational and educational
2. General education and professionally oriented
3. Humanitarian and technocratic

Classification of pedagogical technologies by organizational forms

1. Extracurricular and alternative
2. Academic and club
3. Individual and group
4. Collective training
5. Differentiated education

Self-preparation for innovative pedagogical activity

The main types of self-training:

• Reading pedagogical periodicals, methodical, and pedagogical literature.

• Review of information on the Internet on discipline, pedagogy, and psychology.

• Performing exercises, tests, crosswords.

• Attending seminars, trainings, conferences.

• Discussions, and exchange of experience with colleagues.

• Study of modern psychological methods through interactive training.

• Completion of professional development courses.

• Organization of group and extracurricular activities.

• Studying the possibilities of information and communication technologies.

• Visiting exhibitions and thematic excursions.

• Communicating with colleagues on the Internet, using educational social services.

Classes on the problems of innovative learning are accompanied by diagnostics, questionnaires, and the performance of creative tasks, which require pedagogical reflection. The effectiveness of the professional development of teachers is determined by a well-thought-out system of department activities, in particular methodical seminars, which allow teachers to build their professional activities at a high level and contribute to their professional self-realization and further self-development [8, 9, 20, 21].

3. Development of research and organizational skills in the preparation of innovative projects of education and agricultural production

Scientific research work of students is an important component of the

professional training of future specialists, as it helps students develop a set of necessary knowledge, skills, and abilities. This work has a creative nature, which contributes to the formation of students' ability to predict results, formulate goals and hypotheses, as well as search for independent ways to solve problems [10, 18, 20].

The main goals of students' research work

1. Development of research, experimental, and theoretical knowledge, skills and abilities.

2. Formation of dialectical logic and scientific thinking.

3. Formation of a scientific outlook and mastering the methods of scientific knowledge.

4. Conscious assimilation and consolidation of the material being studied.

5. Development of independence, communication, and organizational skills.

6. Formation of a professional and cultural outlook through the integration of the educational process and scientific progress.

7. Creation of positive motivation and sustained interest in the specialty and research work.

8. Facilitating the solution of current scientific and technical problems and obtaining generally significant scientific and practical results.

9. Use of developed scientific concepts in practical activities.

10. Development of public speaking skills and participation in scientific discussion.

11. Development of literary work skills - abstract, bibliographic, and author's.

12. Inclusion in active cognitive activity of innovative research forms of education.

13. Modernization of professional training through updating the educational standard and going beyond it.

14. Development of creative activity in the specialty according to the individual characteristics of the student.

15. Development of self-discipline, organization, and skills of planned systematic work.

The value of research work for professional training

The scientific and research work of students contributes to the improvement of the quality of their professional training. It forms the ability

to think independently and creatively and develops personal qualities such as independence, communication, and organizational skills. This provides future specialists with the ability to apply scientific methods in industrial settings, which is a key aspect of their professional activities.

Thus, the research work of students at universities is a necessary component of training highly qualified specialists who can work effectively in their field, using scientific approaches and innovative technologies.

Development of scientific and pedagogical abilities of students

The research work of students develops through several stages, which include different levels of independent activity:

1. Adaptation to scientific research: Students study the methods of scientific research, and perform reproductive and reproductive-research tasks.

2. Active educational and research activities: Engage in independent work, and solve research problems.

3. Participation in educational research: The volume of independent work increases.

4. Industrial and scientific research: Combine educational and practical research.

The active component of research work emphasizes the independent development of personality and creative abilities. Students' cognitive independence allows them to apply knowledge in new situations and develop a creative approach to the use of the acquired knowledge.

Classification of pedagogical abilities

Pedagogical abilities include:

1. Organizational: the ability to organize group activities and interact effectively with others.

2. Predictive: the ability to predict the results of pedagogical influence.

3. Didactic: the ability to develop and implement educational programs.

4. Perceptive: the ability to perceive and understand information.

5. Communicative: the ability to communicate effectively.

6. Research: the ability for scientific research and analysis.

Development of pedagogical skills in universities

Organizational abilities are developed through group forms of work, including the role of leader and team member. Example:

Group exercises: "Get out of the circle" and "Persuasiveness" help

students develop energy, initiative, creativity, critical thinking, and the ability to argue their point of view.

Prognostic abilities are developed through solving pedagogical problems, which helps to understand the logic of the pedagogical process, patterns of development of schoolchildren and predict the results of pedagogical influence.

Didactic and communicative abilities are formed through educational disciplines, especially the pedagogy course, which includes the analysis of pedagogical phenomena, the development of educational programs and participation in pedagogical discussions.

Thus, effective training in higher education institutions should include various forms and methods of work that contribute to the development of both scientific and pedagogical abilities of students, preparing them for professional activities.

Development of prognostic abilities

The development of students' predictive abilities includes the ability to see the future, critically evaluate the past and present, and predict their professional future. During seminar classes, students have the opportunity to analyze future trends in the professional field, which helps them predict possible changes in agricultural production and education. The application of case methods, where students consider real or simulated situations, allows them to make predictions of results based on the obtained data.

Critical thinking and reflection are important aspects of this process. Students can study the history and evolution of professional practices, which helps them understand the influence of the past on the present. Reflection on one's own development allows students to plan their future. Strategic planning is also important, and students may be involved in projects that require long-term planning and a strategic approach, such as developing business plans for agricultural projects or educational innovations.

Development of didactic abilities

The development of students' didactic abilities includes the ability to logically, consistently, and present educational material. During seminar classes, students learn to present the material, confirming the theoretical propositions with examples from school life, and quotes from prominent people, and to make the presentation accessible and interesting for others. This contributes to the development of argumentation skills, encouraging discussion and generating interest in the topic.

Active learning is an important part of this process. Students participate in discussions, debates, and group projects, which helps them develop communication skills and the ability to argue their points of view. Innovative teaching methods, such as interactive technologies and projects involving active participation in research and practical tasks, also contribute to the development of didactic abilities.

The goal of professional growth

The goal of professional growth in education and agricultural production is the formation of deep knowledge and practical skills in students, awareness of the paradigm of education and pedagogy, as well as mastering research methods and system analysis. It is important to instill practical skills in students and familiarize them with strategic planning methods. Providing a comfortable moral and psychological environment, developing communication and organizational skills, as well as stimulating innovative projects contribute to the personal growth and professional training of students.

Involving students in active participation in innovative projects and using the acquired knowledge in practice helps them achieve their personal and professional goals. Such approaches contribute to the development of creative activity, self-discipline, and systematic work, which are key aspects of their professional and personal growth.

General method of performing scientific research work

The methodology of scientific research includes several key stages. First, it is necessary to formulate the problem-research situation and define the research task. Then it is important to clearly understand the purpose of the research, to develop the final and intermediate goals. The next stage is an analytical review of theoretical and experimental research on the chosen topic, as well as an analysis of facts, their connections and relationships, conditions, and methods of solving similar problems.

The next step involves making assumptions and formulating a working hypothesis. After that, you should choose the appropriate research methods and techniques, and plan and organize the experiment. It is important to solve the research task through theoretical substantiation and hypothesis testing. Practical verification of research results is carried out through experiment, observation, and hypothesis testing. The final stage is the systematization of the results, their analysis, generalization, formulation of conclusions, and assessment of the theoretical and practical significance of scientific achievements.

Formation of the content of education

Forming the content of education is a complex process that requires a balance between fundamental knowledge and practical skills. It should ensure the transformation of educational information into knowledge and skills, as well as promote the development of the ability to work independently. The content of education must meet the needs of society and the labor market, ensuring the preparation of students for professional activities.

Activity of teacher-researchers

Teacher-researchers are characterized by a deep analytical approach, innovative methods, and the ability to forecast. They should comprehensively study the research object, realize its importance, find contradictions, and formulate the main goals and objectives. Pedagogical research is organized in such a way as to stimulate the cognitive activity of students and create situations of moral choice.

The success of research activities of teachers depends on several conditions:

• Goals and objectives should correspond to real problems in the school.

• Regulatory, organizational, and scientific-methodological support is necessary.

• Teachers should be ready for innovative changes.

• The organization of research activities should be systematic.

Being a teacher-researcher means:

• To be able to find new aspects in pedagogical phenomena and processes, to reveal hidden connections and regularities.

• Think, conduct imaginary experiments, and take into account various conditions and factors.

• Look for contradictions, measure everything that can be measured, and propose new theoretical and methodological solutions.

• Master research methods, classify and statistically process material, as well as draw conclusions and issue practical recommendations [13,17,18**]**.

One of the effective forms of development of the personal and professional skills of students is student self-government. This is a process in which students, starting from the first years, are actively involved in public activities, which contributes to the development of leadership

qualities and organizational skills. Student self-government unites individual, group, and collective forms of activity, including participation in social and pedagogical events. This stimulates the development of partnership interaction, planning, and coordination of joint actions, and forms social competence and important organizational skills, which are relevant for future professional activities.

To maximize the potential of student self-government for the formation of organizational skills of future teachers, the "School of a Young Leader" program was developed. Its main principles include 1) selection of means of training taking into account the initial level of organizational abilities of students; 2) creation of conditions for the realization of organizational inclinations of each student; 3) integration of theoretical and practical activities; 4) organization of interaction based on democratic principles and dialogue.

The method of formation of organizational abilities within the framework of the "School of a Young Leader" program involves the use of content, forms, and methods that include the participation of students in various aspects of student life. This covers work at Group, Stream, Faculty, Institute, Hostel, and University levels. The program has a variety of organizational forms, such as a starost, student dean's office, and council, as well as relevant regulatory and legal regulations.

Formation of organizational skills under the "School of a Young Leader" program is carried out through three main areas of activity:

1. Work in student self-government using group forms, such as role-playing games, collective creative tasks, problem discussions, conversations, and training.

2. Carrying out organizational tasks at the level of the academic group and institute (faculty), including discussions, briefings, and business games.

3. Activities of the Student Self-Government Council of the University, which includes regulation, independent organization of affairs, and training [15,16].

Therefore, the main condition for the formation of the content of education is the integration of scientific disciplines with the professional and personal development of the future specialist. This ensures the organization of the educational process, which not only focuses on the deep assimilation of the knowledge system by students but also on the development of their knowledge acquisition skills. This approach has a

significant positive impact on the quality of education received by future specialists.

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PSYCHOLOGICAL AND PEDAGOGICAL DISCOURSE IN PROFESSIONAL EDUCATION

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1. Modern global trends in vocational education

Vocational education aims to ensure the professional self-realization of individuals, form their qualification level, and create a socially active, morally and physically healthy national production potential. This potential should play a crucial role in the technological renewal of production and the implementation of scientific and technical achievements into practice. The main tasks of vocational education include: creating conditions for acquiring working professions according to the vocations, interests, abilities, and physical condition of citizens, improving production qualifications and retraining at the level of scientific and technical achievements, ensuring national and regional needs for qualified personnel who are competitive in market conditions, and elevating vocational education in Ukraine to the level of achievements of developed countries. The primary functions of vocational education are social, economic, cultural, educational, and cognitive. These functions are realized through systematic interaction between educational institutions of various types and forms of ownership, enterprises and organizations from all economic sectors, social partners, public organizations, united territorial communities, and state authorities and management bodies.

Modern global trends in vocational education include several key directions reflecting the adaptation of educational systems to new challenges and demands of the global labor market. These include digitalization and innovative technologies. Digitalization of vocational education involves the integration of information and communication technologies (ICT) into the educational process. Smart education and ICT are rapidly being implemented and utilized to create interactive and flexible learning environments, including online platforms, virtual laboratories, simulation trainers, and educational programs using artificial intelligence.

Key trends in vocational education globally

1. Digitalization and innovative technologies

Digitalization in vocational education involves integrating information and communication technologies (ICT) into the educational process. Smart education and ICT are rapidly being implemented and utilized to create interactive and flexible learning environments, including online platforms, virtual laboratories, simulation trainers, and educational programs using artificial intelligence.

2. Simulation-based learning

Simulation-based learning allows students to acquire practical skills in a safe and controlled environment. This is particularly important for preparing specialists in technical and medical fields. It helps students gain hands-on experience without the risks associated with real-world scenarios.

3. Development of digital skills

Emphasis is placed on training specialists with high levels of digital competence, including knowledge of modern information technologies, programming, data analysis, and cybersecurity. This ensures that graduates are well-equipped to meet the demands of the modern workforce.

4. Integration of STEM education

The integration of STEM (Science, Technology, Engineering, Mathematics) education into society is another significant trend. STEM centers and laboratories provide students with access to modern equipment and programs, fostering their research activities. The use of scientific, technological, engineering, and mathematical disciplines helps develop critical thinking, problem-solving approaches, and innovative solutions, forming the necessary competencies for work in high-tech industries.

Challenges in implementing digital and innovative technologies

Despite the significant advantages of implementing digital and innovative technologies in vocational education, certain challenges must be addressed. One of the primary challenges is the need for continuous updating of the material and technical base of educational institutions. Additionally, there is a necessity for ongoing professional development of teaching staff in the field of digital technologies. Ensuring equal access to digital resources for all students, regardless of their socio-economic status, is also crucial to achieving inclusive and equitable vocational education.

By addressing these challenges and leveraging the benefits of digital and innovative technologies, vocational education can significantly enhance

its effectiveness and relevance in the modern world, preparing individuals for successful careers in a rapidly evolving global economy.

Dual education and its alignment with modern global trends in vocational education

Dual education also corresponds to modern global trends in vocational education. The dual education system, as a model of learning that combines theoretical training in educational institutions with practical training in workplaces, is one of the key trends in the development of vocational education. This model is actively implemented in many countries around the world and demonstrates high efficiency in training qualified personnel. Dual education involves the integration of educational institutions and enterprises into a single educational and production system. Students studying under this system spend part of their time in classrooms and the other part directly in production. This allows combining theoretical knowledge with practical skills, significantly increasing their competitiveness in the labor market.

The main advantages of dual education are:

1. High quality of training: by combining theoretical and practical training, it ensures a deep understanding of the material and the development of professional skills.

2. Improved employment prospects: graduates of dual programs have practical experience, making them more attractive to employers.

3. Economic benefit for employers: employers gain the opportunity to prepare personnel that meet their specific needs, reducing the costs associated with adapting new employees.

In Ukraine, the dual education system is implemented within the framework of the vocational education modernization strategy. This includes the creation of training and practice centers, career centers, and business centers in vocational education institutions. The concept of training specialists through dual education in Ukraine outlines the main tasks for the implementation of this system. The primary task is to eliminate the gap between theory and practice, improve the quality of training of qualified personnel considering employers' requirements, and ensure successful employment of graduates.

The implementation of the dual education system requires close cooperation between educational institutions and enterprises, as well as state support in the form of tax incentives and other economic stimuli for

employers. Additionally, it is necessary to create a regulatory framework that will govern the relationships between all participants in the educational process.

The dual education system is an effective model for training qualified personnel, ensuring high quality education and promoting the employment of graduates. Its implementation in Ukraine requires a systematic approach and close cooperation between the state, educational institutions, and enterprises.

Individualization of learning as a key trend in modern professional education

Individualization of learning is becoming one of the key trends in modern professional education, aimed at ensuring maximum alignment of the educational process with the individual needs, abilities, and interests of each student. This approach allows increasing motivation for learning, ensuring more effective knowledge acquisition, and fostering the development of creative abilities.

Individualization of learning involves creating conditions where each student has the opportunity to learn according to an individualized program that considers their specific characteristics. This is achieved through the use of various methods and forms of learning, such as differentiated tasks, project activities, independent work, and more. The creation of an individualized educational trajectory, opportunities for individual planning of the learning process considering the needs, interests, and development pace of each student, flexibility in choosing learning modules, online courses, and practices.

The main advantages of individualizing learning are:

1. Increased motivation for learning: students who learn through individualized programs feel more engaged in the learning process.

2. Optimization of the learning process: an individualized approach helps avoid student overload and ensures more effective assimilation of learning material.

3. Development of creative abilities: individualization of learning promotes the development of creative thinking and the ability to make unconventional decisions.

Individualization of learning requires significant resources, both material and human. Teachers must be highly qualified and skilled in working with modern technologies, as well as in developing individualized

learning plans. Additionally, it is necessary to provide students with access to modern information resources and technologies.

Individualization of learning is an important component of modern professional education that contributes to improving the quality of specialist training, developing their creative abilities, and ensuring that the educational process meets the individual needs of each student.

International cooperation and standardization in professional education

The issue of Ukraine's European integration into the EU countries is particularly acute now, making international cooperation and standardization in professional education quite relevant.

International cooperation and standardization are key components in the development of modern professional education. They contribute to improving the quality of education, ensuring the competitiveness of graduates in the international labor market, and integrating national educational systems into the global context.

International cooperation in professional education includes student and teacher exchanges, joint research projects, participation in international educational programs and projects, and collaboration with international organizations and associations. These initiatives help expand learning horizons, implement best practices and innovative teaching methods, and improve the professional qualifications of teachers.

The main directions of international cooperation are:

1. Academic mobility: participation in student and teacher exchange programs such as Erasmus+.

2. Joint educational programs: development and implementation of joint training programs with foreign partners.

3. International scientific research: participation in joint scientific research and projects with foreign educational and research institutions.

Standardization of professional education involves developing and implementing uniform quality standards of education that meet international requirements and ensure high-quality specialist training. This includes the harmonization of educational programs, the introduction of a credit module system (ECTS), and the certification and accreditation of educational programs at the international level.

1. Harmonization of educational programs: ensuring the compliance

of national educational programs with international standards.

2. Credit module system (ECTS): implementing the ECTS system to ensure the transparency and comparability of educational programs.

3. International accreditation: certification and accreditation of educational programs at the international level to ensure their quality and recognition worldwide.

The implementation of international standards and the development of international cooperation require significant efforts and resources. The main challenges are the need to adapt national educational systems to international requirements, to improve the qualifications of teachers, and to provide financial support for the implementation of international programs and projects.

However, international cooperation and standardization open significant prospects for the development of professional education, enhancing its quality, and increasing the competitiveness of graduates in the international labor market.

International cooperation and standardization are integral components of modern professional education, contributing to its integration into the global educational space, improving the quality of specialist training, and ensuring the competitiveness of graduates in the international labor market.

Future challenges demand the adaptation and modernization of the professional education system to meet the needs of a rapidly changing world. An important task is to train qualified specialists capable of effectively working in conditions of global changes and innovative technologies.

With the development of modern times, the issue of preparation for future challenges, along with the flexibility and adaptability of educational programs, is quite relevant. The questions arise about updating the content of education, including the latest knowledge and technologies, adapting to changes in labor market requirements, developing self-education and lifelong learning skills, forming students' social responsibility, ethical thinking, and active citizenship, and ensuring equal access to professional education for all segments of the population, including people with disabilities and representatives of socially vulnerable groups.

Finally, raising the prestige of working professions is quite relevant and painful. In many countries, working professions often have a low social status compared to academic or managerial specialties. This may be related

to historical prejudices, cultural stereotypes, or a lack of awareness of the opportunities these professions provide. Technological progress and automation lead to changes in the requirements for working professions. On the one hand, new technologies can increase skill requirements, while on the other hand, they can reduce the need for human labor for routine tasks. Salary, working conditions, job stability, and career growth opportunities are important factors affecting prestige. In many cases, low wages and harsh working conditions reduce the attractiveness of working professions. Social stereotypes about the "low status" of working professions can influence young people's career choices. Many people believe that only academic or highly qualified professions are prestigious. The availability of modern educational programs that meet labor market needs can raise the prestige of working professions. Educational institutions that offer high-quality training and certification help increase the level of professionalism and, accordingly, prestige. Partnerships between educational institutions and enterprises can provide students with practical experience and expand their employment opportunities, positively impacting the profession's prestige. The state of prestige of working professions can vary significantly depending on the country.

In some countries, for example, in Germany or Sweden, working professions have higher status due to a strong system of vocational training and state support. Globalization and international exchange can also influence the prestige of professions. For example, the introduction of international standards and practices can increase the requirements for professions and, accordingly, their prestige. Improving working conditions, increasing wages, and providing opportunities for professional growth can help raise the prestige of working professions. Public and private support programs, including financial aid and scholarships, can encourage young people to choose working professions. It is necessary to implement programs to popularize vocational education, actively work with youth and the public to increase interest in working professions, change negative attitudes towards them, and popularize successful examples of career growth in technical and production fields.

These trends indicate the need for continuous renewal and modernization of vocational education to prepare specialists capable of working effectively in conditions of rapid technological changes and global competition. In light of global changes occurring in economic,

technological, and social spheres, vocational education is undergoing significant transformations. Analyzing current global trends in this field allows us to identify several key development directions. Vocational education is increasingly integrating with new technologies such as artificial intelligence, automation, and digital platforms. This leads to the need for constant updating of educational programs and methodologies to meet modern labor market requirements and provide students with skills that match the needs of technological progress. Instead of the traditional approach to education focused on theoretical knowledge, modern vocational education emphasizes the development of competencies and practical skills.

This allows students to be better prepared for real working conditions and adapt to a rapidly changing labor market. Vocational education is becoming increasingly global, with a focus on international standards and experience exchange. The development of global educational platforms, international certifications, and student mobility allows expanding the boundaries of learning and providing access to quality education anywhere in the world. The trend towards personalized education based on individual needs and interests of students is gaining popularity. The use of data analytics and adaptive learning systems allows for the creation of individualized learning paths and supports students in achieving their professional goals. The role of partnerships between educational institutions and industry is growing. Joint projects, internships, and training programs developed in cooperation with enterprises provide students with real experience and facilitate their transition to the labor market. Modern vocational education increasingly emphasizes lifelong learning and continuous development. Given the rapid changes in technologies and work methods, continuous updating of knowledge and skills becomes a necessity for professional success. Vocational education is increasingly striving to become more inclusive and accessible to different social groups. This includes ensuring equal access to educational resources and opportunities for all, regardless of social or economic status.

Modern global trends in vocational education are characterized by the integration of new technologies, a focus on competencies, globalization, personalized learning, collaboration with industry, an emphasis on lifelong learning, and a commitment to inclusivity. These trends shape a new approach to training professionals that meets modern labor market requirements and ensures competitiveness in the global context.

2. Innovative teaching technologies in the vocational training of qualified specialists in EU countries

The modern world is rapidly changing, and these changes affect all aspects of life, including education. Higher education, a key component in the preparation of specialists, must also adapt to new challenges. Innovative technologies play a crucial role in this process, providing more effective, accessible, and engaging learning.

Information and Communication Technologies (ICT) form the basis of the modern educational process. They involve the use of computers, the internet, software, and various multimedia tools to support learning. ICT enables educators to create interactive educational materials, conduct distance learning sessions, and provide students with access to global information resources.

Information and Communication Technologies (ICT) play a central role in transforming the educational process in higher education institutions. The use of ICT enhances learning efficiency, provides access to vast amounts of information, facilitates communication among participants in the educational process, and opens up new opportunities for personalized learning.

Key aspects of ICT in education:

Electronic educational resources

Digital textbooks and educational materials that provide convenience in use and information updating.

Online courses and platforms: MOOCs (Massive Open Online Courses) like Coursera, edX, and Udemy allow students to acquire knowledge from leading global universities.

Virtual learning environments (VLE)

Learning management systems (LMS) such as Moodle, Blackboard, and Google Classroom integrate educational materials, tests, forums, and other communication tools.

Virtual laboratories: allow students to perform experimental tasks in an online environment, simulating real processes and situations.

Interactive teaching methods

Multimedia presentations: use of presentations, videos, audio, and animations to illustrate educational materials.

Interactive boards and panels: tools that allow educators to

interactively engage with students, demonstrate, and explain complex concepts.

Distance learning

Videoconferences and webinars: platforms like Zoom, Microsoft Teams, and Google Meet enable real-time lectures, seminars, and consultations.

Asynchronous learning: provision of educational materials, assignments, and tests for independent study at a convenient time for students.

Cloud technologies

Cloud services: tools like Google Drive, Dropbox, and OneDrive facilitate document storage, sharing, and collaborative work on documents and projects.

Cloud computing: provides powerful computational resources for performing complex tasks and data analysis.

Mobile technologies

Learning apps: applications like Duolingo, Khan Academy, and Quizlet allow studying new subjects and practicing skills via smartphones and tablets.

Electronic libraries: access to scientific articles, books, and journals through mobile devices.

Social networks and online communities

Social Platforms: Sites like Facebook, LinkedIn, and Research Gate are used for knowledge sharing, discussions, and professional networking.

Online communities: students can form interest groups, share experiences, and collaboratively solve educational tasks.

Analytics and artificial intelligence:

Educational analytics

Use of student performance data to improve educational programs and personalize learning.

Artificial intelligence: development of adaptive learning systems that cater to each student's needs and provide personalized recommendations.

Thus, the main elements of an innovative educational process include computer systems, communication tools, information resources, mathematical, cybernetic, and informational methods, as well as organizational structures for informational service.

ICT transforms traditional approaches to learning and teaching,

making them more interactive, accessible, and effective. They contribute to the development of students' digital literacy, which is a crucial aspect of preparation for the modern labor market. The integration of ICT into the educational process ensures a high level of education quality and creates conditions for continuous professional development.

Virtual laboratories and simulation trainers

Virtual laboratories and simulation trainers are innovative tools used for modeling real processes and situations in an educational setting. They provide students with the opportunity to practice and acquire skills without risks to health, equipment, or finances. The main characteristics of these technologies include: realism,

Interactivity, safety, cost-effectiveness.

Common virtual laboratories and platforms

Chemistry and biology

PhET Interactive Simulations: a free platform offering interactive simulations in chemistry, physics, biology, and other sciences. Students can conduct virtual experiments, exploring the behavior of chemical substances and biological systems.

Labster: a virtual laboratory providing simulations for studying biology, chemistry, and medicine. For example, students can simulate genetic research or microbiological experiments.

Medical studies

3D Organon Anatomy: a virtual anatomical trainer allowing medical students to study the human body using 3D models.

OSCE Virtual Reality (VR): a simulator for preparing medical students for the Objective Structured Clinical Examination (OSCE), using virtual reality technologies.

Engineering and technical sciences

ANSYS: software for engineering modeling and simulation, allowing students to analyze mechanical structures, thermal processes, and other engineering tasks.

MATLAB & Simulink: tools for modeling and simulating complex technical systems, widely used in engineering and computer science education.

Economics and Business

Simul Train: a business simulation that allows students to practice project management, decision-making, and conflict resolution in a virtual

environment.

Marketplace Simulations: business simulations covering various aspects of enterprise management, from marketing to finance and strategic planning.

Aviation and military training

Flight Simulator X: an aviation simulator used for pilot training, allowing them to practice aircraft control skills in different conditions.

VBS3 (Virtual Battlespace 3): a military simulator used for training military units in various tactical operations and scenarios.

Implementation in leading universities

Massachusetts Institute of Technology (MIT)

MIT uses virtual laboratories to conduct experiments in physics and chemistry. For example, students can perform experiments such as analyzing light spectra or studying chemical reactions using virtual tools. Simulink and MATLAB are used for modeling and simulating complex engineering systems in real conditions. Students can develop and test models before their actual implementation.

Stanford University

Stanford Virtual Heart: a virtual simulator allowing medical students to study the structure and functions of the heart in an interactive 3D environment, enhancing their understanding of heart anatomy and pathology.

Anatomage Table: an interactive virtual anatomical table providing high-quality 3D images for studying the human body.

University of Pennsylvania

Virtual Dental Simulation Clinic: dental students use simulators to practice dental procedures in a safe and controlled environment, including various dental interventions.

V-Sim: a program for training medical students in clinical skills, particularly patient care. Students practice their skills in a virtual environment, helping them prepare for real clinical practice.

European universities

University of Cambridge (UK)

Labster: used for teaching biology, chemistry, and medicine. Labster's virtual laboratories allow students to perform experiments that are difficult or dangerous to conduct in real conditions.

PhET Interactive Simulations: a platform for simulations in physics,

chemistry, and other natural sciences, actively used for interactive learning.

ETH Zurich (Switzerland)

Simulink and MATLAB: widely used for modeling engineering systems and conducting simulations. Students work on projects that require the use of complex mathematical models and algorithms.

Virtual Reality Lab: a lab where students can model and explore physical processes in an interactive environment.

University of Leuven (Belgium)

Anatomy Learning Center: uses virtual 3D models for studying anatomy. Students can interact with virtual models of organs and systems of the human body.

VR Simulators for medical students

University of Oslo (Norway):

Virtual Sim: a platform for simulating clinical scenarios used for training medical students. Students can practice diagnostic and therapeutic skills in a virtual environment.

Open edX: an online course platform that also utilizes virtual labs for practical training in various disciplines.

Benefits of virtual labs and simulation trainers

Virtual labs and simulation trainers are essential tools in modern education, providing students with the opportunity to gain practical skills in a safe, accessible, and cost-effective environment. Higher education institutions in the USA and Europe are actively incorporating these technologies into their curricula, ensuring a high level of student preparation for professional activities.

Key Benefits

Realism: virtual labs and simulators recreate real conditions and processes, allowing students to gain experience as close to reality as possible.

Interactivity: Students can interact with the virtual environment, conducting experiments, making decisions, and observing the outcomes of their actions.

Safety: the ability to perform dangerous or complex experiments in a safe virtual environment.

Accessibility: access to virtual labs and trainers is possible from anywhere, significantly expanding learning opportunities.

Cost-effectiveness: reducing costs for materials, equipment, and

maintaining physical laboratories.

STEM education

STEM education is gaining increasing popularity due to its focus on innovative technologies. It aims to develop students' motivation, research, and creative thinking. STEM labs and centers provide students with access to modern equipment and programs, enabling them to conduct research and develop practical skills. STEM education, which integrates Science, Technology, Engineering, and Mathematics, was first proposed in the 1990s and became widely used after its promotion by the National Science Foundation (NSF) in the USA. STEM education focuses on an integrated approach to learning, encouraging students to apply knowledge and skills from different disciplines to solve real-world problems.

Key characteristics of STEM education

- Integration of disciplines: science, technology, engineering, and mathematics are taught not as separate subjects but as interconnected areas of knowledge.
- Practical orientation: educational programs include project activities and experimental tasks, allowing students to apply theory in practice.
- Development of critical thinking and creative abilities: students learn to analyze information, make informed decisions, and find innovative solutions to complex problems.

STEM education is implemented at various educational levels and institutions. Many schools incorporate STEM subjects into their curricula, organizing specialized courses and clubs that foster students' interest in science, technology, engineering, and mathematics. Specialized STEM schools, such as Thomas Jefferson High School for Science and Technology in the USA, provide in-depth study of STEM disciplines. Universities and colleges offer programs in engineering, computer science, biotechnology, and other STEM fields. Research labs and institutes provide students with opportunities to conduct research and participate in real scientific projects. STEM camps and extracurricular programs allow children and teenagers to engage in science and technology in an interactive and enjoyable format. Organizations like FIRST (For Inspiration and Recognition of Science and Technology) hold robotics competitions and other events promoting the development of STEM skills. Many companies collaborate with educational institutions, providing internships, equipment, and expertise to support

STEM education. Corporate training programs also often include STEM components.

STEM education is a key component of the modern educational process, preparing specialists capable of solving complex technical and scientific problems. Its integrated approach, practical orientation, and focus on critical thinking development make STEM education an important factor in preparing youth for the challenges of the 21st century.

Teamwork and collaboration skills

Significant attention is paid to developing collaboration, communication, and teamwork skills. One common example of teamwork in higher education is the implementation of a project-based learning approach. In this case, students form teams to carry out specific projects that can be interdisciplinary and have real-world applications. With the rapid advancement of innovative technologies, teamwork has become increasingly important. For instance, in a "Software Development" course, teams are formed by grouping students with diverse skills and knowledge (e.g., programmers, designers, project managers). Project selection and team roles each team selects or receives an assignment to develop a software product (e.g., a mobile application, website, or software tool). The project includes requirements analysis, planning, development, testing, and presentation of the final product. Then, roles are distributed within the team (project leader, developer, tester, designer, analyst). Each participant is responsible for their part of the work, but all team members collaborate and assist each other.

During the project, teams hold regular meetings to discuss progress, solve problems, and adjust action plans. Tools such as Trello, Slack, and GitHub are used for effective communication and project management. At the end of the semester, each team presents its project to teachers and other students. The presentation includes a demonstration of the product's functionality, a description of the development process, challenges faced, and solutions found.

Authors on teamwork

- J. Richard Hackman: known for his research in organizational psychology and group behavior. His book "Leading Teams: Setting the Stage for Great Performances" outlines the key principles of effective teamwork and leadership.

- Edward de Bono: author of the "Six Thinking Hats" concept, used to improve teamwork and decision-making. His works include "Six Thinking Hats" and "Lateral Thinking."
- Patrick Lencioni: author of "The Five Dysfunctions of a Team," which describes the main problems teams face and how to overcome them.
- Meredith Belbin: known for his research on team roles and the "Team Roles" model. His works include "Management Teams: Why They Succeed or Fail" and "Team Roles at Work."
- Bruce Tuckman: developed the team development model known as "Tuckman's stages of group development" (Forming, Storming, Norming, Performing). His research significantly impacted the understanding of team development processes.

The importance of teamwork in education

Teamwork is an integral part of modern education in higher education institutions, promoting the development of collaboration, communication, and problem-solving skills. The use of project-based approaches and other teamwork methods helps students gain valuable practical experience, preparing them for real-world professional challenges. Working together, students learn to trust each other, share responsibilities, and achieve common goals, which are key aspects of successful teamwork.

Creating a professional environment

A professional environment should match the abilities, needs, and opportunities of each individual. This allows for a personalized approach to student education and development. "Creating a professional environment" in the context of innovative teaching technologies in higher education means creating an educational and learning space that maximally corresponds to each student's abilities, needs, and opportunities. This environment should provide conditions for developing professional skills, stimulate creative potential, and support motivation for learning.

Key aspects of creating a professional environment

- Individual approach to learning: developing individual learning plans that consider each student's personal interests, abilities, and goals. Using adaptive learning programs that allow students to learn at their own pace.
- Interactive learning: utilizing interactive teaching methods, such as group projects, discussions, simulations, and role-playing games, that encourage active student participation in the learning process. Engaging

students in real projects and practical tasks to apply theoretical knowledge in practice.

Distance and blended learning

Distance and blended learning (a combination of face-to-face and distance learning) have become particularly relevant during the COVID-19 pandemic. These forms of learning provide flexibility, allowing students to study at a convenient time and place. Teachers can use various online platforms for classes, consultations, group work, and student assessment. Automation of control and assessment processes significantly increases the effectiveness of learning.

At Kharkiv State University of Biotechnology, the Moodle system is widely used, allowing students to review lecture materials and complete independent work at a convenient time. Teachers can also conduct consultations and assess students' knowledge remotely, which is particularly important during wartime.

Interactive learning methods

Interactive methods of learning, such as visual and computer modeling of various phenomena and processes, contribute to a deeper understanding of the material. Teachers can use multimedia projectors to demonstrate educational materials, helping students better grasp information. Intelligent learning tools and environments ensure the development of professional knowledge, skills, and abilities, as well as students' creative and research capabilities.

Interactive learning methods are based on active interaction between teachers and students, as well as among students themselves. They aim to stimulate critical thinking, develop communication skills, and engage students in the learning process.

Characteristics of interactive learning methods

- Active student participation: students are not passive listeners; they actively participate in discussions, group tasks, and other activities.
- Collaboration and teamwork: interactive methods often involve group work, fostering collaboration and teamwork skills.
- Feedback: regular feedback from teachers and peers helps students better understand the material and improve their skills.
- Development of critical thinking: students are encouraged to analyze, evaluate, and synthesize information, promoting critical thinking.

Application of interactive learning methods in higher education

- Discussions and debates: teachers organize discussions or debates on specific topics where students can express their opinions, justify them, and discuss with peers. This develops argumentation and critical thinking skills.
- Group projects: students work in groups on joint projects involving research, analysis, and presentation of results. This develops collaboration, leadership, and time management skills.
- Role-playing games and simulations: students take on roles in simulation scenarios, helping them understand complex concepts and develop practical skills. For example, law schools use mock trials where students act as lawyers, judges, and witnesses.
- Case Studies: teachers use real or fictional situations for students to analyze and discuss. Students study the case, identify problems, discuss possible solutions, and propose the best course of action.
- Interactive lectures: teachers use technology to engage students during lectures, such as through interactive polls or short group discussions.
- Forum discussions: using online forums to discuss educational topics allows students to exchange ideas and receive feedback at their convenience.

Examples of interactive technologies in education

- Interactive whiteboards (Smart Boards): teachers can use interactive whiteboards to demonstrate materials, conduct polls, and organize group discussions.
- Online platforms (Moodle, Blackboard): these platforms provide opportunities for sharing materials, conducting tests, forum discussions, and feedback.
- Audience response systems (Clickers): used for quick polls during lectures, allowing teachers to get immediate feedback from students.

Interactive learning methods can be applied in various educational settings and disciplines, making the learning process more engaging and effective.

- Virtual laboratories and simulators: students can conduct experiments or participate in simulation training using virtual environments, which helps them acquire practical skills in safe conditions.

Interactive learning methods are a powerful tool in modern education, promoting a deep understanding of the material, the development of critical thinking, communication, and collaborative skills. Their use in the

educational process makes learning more engaging, effective, and adaptable to the needs of contemporary students.

Thus, innovative technologies play a key role in the modern educational process in higher education institutions. They not only enhance the effectiveness of learning but also make it more accessible and engaging. The use of ICT, virtual laboratories, simulation trainers, STEM education, distance and blended learning, as well as interactive teaching methods, contribute to the preparation of highly qualified specialists capable of working effectively in the modern world.

Innovative teaching technologies in Western European countries include various approaches aimed at improving the quality and accessibility of vocational education.

The main development directions include:

- Modern educational technologies (using information and communication technologies (ICT) to create interactive and multimedia educational materials. Utilizing online platforms for distance learning, which provides flexibility in the choice of place and time for studying).
- Professional development support (organizing internships, practices, and cooperation with business and industry, giving students the opportunity to gain real work experience. Supporting professional development and lifelong learning programs, allowing students to continuously update their knowledge and skills).
- Psychological and social support (creating psychological and social services that help students cope with academic and personal difficulties. Ensuring comfortable learning conditions, including modern educational facilities, laboratories, libraries, and recreational areas).
- Inclusiveness and equality (ensuring access to education for all students regardless of their physical abilities, social status, or other limitations. Creating conditions for integrating students with special needs into the general educational process).

Thus, the creation of a professional environment in higher education institutions aims to ensure maximum efficiency in the learning and professional development of students, tailored to their individual needs and capabilities.

Professional education consists of several levels and directions, involving different terms of study and sets of specialties. It is important to ensure continuity between programs of different levels, allowing students to

seamlessly continue their education and career development. Professional educational institutions operate on the basis of the distribution of functions between educational institutions, enterprises, and organizations that are part of the educational complex or cluster. This promotes closer cooperation between education and business, which enhances the quality of specialist training.

An important element is the creation of support services, such as adaptation, diagnostic, didactic, and psychological centers. They help students successfully adapt to the educational process and solve problems that arise during their studies. An important aspect is the implementation of the European Qualifications Framework and compatible National Qualifications Frameworks. This promotes permeability between different education sectors and ensures international recognition of qualification certificates. The higher level of qualifications frameworks encompasses both sectors with transparent links between ECTS units in higher education and ECVET in vocational education.

To improve the quality of vocational education, effective quality assurance systems are developed at the institutional, national, and pan-European levels.

The active use of innovative teaching methods and technologies is a key factor in modern vocational education. The use of modern information technologies and distance learning contributes to the creation of a unified European open education space.

These approaches and concepts ensure a high level of training for specialists who can work effectively in the modern world. They aim to create a flexible and accessible system of vocational education that meets the demands of the times and the needs of society.

3. Scientific and methodological aspects of the psychology of creativity in future professionals

The creative potential of an individual is a complex and multifaceted phenomenon determined not only by innate abilities but also by the active efforts of the individual aimed at its development and realization. V.O. Molyako emphasizes the importance of harmonious development of all components of creative potential to achieve high results in creative activities. Creative potential is seen as a set of capabilities that allow an individual to create new, original products, ideas, or solve problems in

unconventional ways.

The development of creative potential includes systematic work on one's abilities, increasing the level of intelligence, developing creative thinking, and constantly enriching one's inner motivational resources.

The structure of creative potential includes several key components:

- Creativity – the ability to generate new ideas, find original solutions, and see unconventional approaches.
- Intellectual abilities – a high level of intelligence that facilitates the analysis, synthesis, and evaluation of new ideas.
- Motivation – an inner need and aspiration for creativity, self-expression, and achieving new heights in a specific field of activity.
- Personal traits – characteristics such as curiosity, self-confidence, a tendency to take risks, an open attitude towards new experiences, flexible thinking, and adaptability.

Creative potential is manifested through the interaction of these components. A high level of intelligence can enhance creativity; however, without sufficient motivation and support from personal traits, this potential may remain unrealized.

The realization of creative potential depends on favorable external conditions such as support from the environment, access to resources, and the ability to experiment and make mistakes without fear of failure.

Psychological components of creativity also need to be considered. Creativity is viewed as the ability to be amazed and to learn, to find solutions in non-standard situations, to be oriented towards discovering new things, and to deeply understand one's experiences. It is a process that involves generating new ideas, approaching problems from different angles, and finding new solutions.

The main approaches to studying creativity include:

- Intellectual approach - considering the creative process as a form of intellectual activity. A high level of creative abilities correlates with a high level of intelligence.
- Processual approach – viewing creativity as a process that includes certain stages and phases. For instance, J. Guilford defined creativity as divergent thinking, the ability to produce various ideas based on given information.

- Personal approach - considering creativity as a personality trait that includes motivation, values, and personal characteristics. For example, A. Maslow and C. Rogers believe that personal characteristics play a key role in determining creative behavior.

Components of creativity:

- Intellectual abilities - necessary but not sufficient for the development of creative activity. A high level of intelligence promotes creativity but does not guarantee it.
- Motivation - strong internal motivation is an important factor in creative activity. Achievement motivation, the need for new knowledge, and self-realization are key components.
- Personal traits - traits such as openness to new experiences, a tendency to take risks, independence in judgments, high tolerance for uncertainty, and the ability for self-reflection contribute to the development of creativity.

Let us consider methods for developing the creative abilities of future professionals. The Brainstorming method, proposed by A.F. Osborn, involves generating ideas in a group without criticism to find new solutions. There is also the method of divergent thinking, which aims to develop the ability to produce many options for solving a single problem, thereby stimulating creativity. The synectics method involves combining different, seemingly incompatible elements to create new ideas and solutions.

Thus, creativity is a multifaceted concept that includes intellectual abilities, motivation, personal traits, and specific thinking processes. Its development in future professionals is crucial for their professional formation and successful activities. Methodological approaches to studying creativity and its development are of great importance for training highly qualified specialists.

Creativity is an important component of personal development, especially in the context of education and professional activity. Considering the psychological components of creativity allows for a deeper understanding of the mechanisms of creative activity and the creation of conditions for its development.

What are the main components of creative thinking:

- Intellectual abilities and knowledge

Intellectual abilities play an important role in creativity, although this connection is complex and not always linear. According to E.P. Torrance's

"threshold theory," at an IQ level above 120, creativity becomes independent of intelligence. Other researchers, like J. Guilford, identify creativity with divergent thinking, which allows the generation of various ideas.

- Imagination and symbolism

Imagination and the ability to symbolize are central components of the creative process. F. Barron emphasizes the importance of imagination, while other researchers highlight the role of metaphors in forming new knowledge and ideas.

- Motivation

Motivation is a key factor in creativity. It includes intrinsic interest, the desire for self-expression, and the aspiration to achieve new heights. R. Sternberg emphasizes the importance of motivation in the development of creative abilities, noting that a person without the right to make mistakes cannot become a creative individual.

- Reflectiveness and goal orientation

Reflectiveness, or the ability for self-reflection and understanding of one’s experience, is an important aspect of creativity. Goal orientation helps focus on achieving specific objectives using creative approaches and methods.

The psychological components of creativity include intellectual abilities, imagination, motivation, reflectiveness, and goal orientation. These components interact, forming the complex structure of the creative process. Understanding and developing these components contribute to the more effective use of an individual's creative potential in various areas of life and activity.

Moreover, it is necessary to discuss methods for developing the creative abilities of future specialists. In modern society, the importance of developing creative abilities is becoming increasingly evident, as creativity is a key component of successful professional activity. This requires the implementation of effective methods for developing students' creative potential in educational institutions. The main methods for developing creative abilities include:

- Brainstorming Method

The essence of this method is group idea generation without criticism to solve specific problems. Participants express any ideas that come to mind, and then the most promising ones are selected for further development. The

undeniable advantage of this method is promoting openness, quickly generating a large number of ideas, and developing teamwork skills. The brainstorming method is successfully used in designing new products at technical universities, significantly reducing the time for developing innovative solutions.

- Synectics Method

The essence of this method is the use of analogies and metaphors to solve problems and generate new ideas. Participants discuss the problem, look for analogies in other areas, and create metaphors that help find new solutions. This method can find non-standard solutions, developing imagination and associative thinking. The synectics method is successfully used in marketing research, helping to find unique ways to promote products on the market.

- Morphological Analysis Method

The essence of the method is analyzing a problem by breaking it down into main components and combining their various options. The main parameters of the problem are identified, different options for each are generated, and then they are combined to find new solutions. This results in a structured approach to idea generation, considering all aspects of the problem.

- Six Thinking Hats Method

Problems are considered from different points of view through role-playing by "wearing" hats of different colors, symbolizing different thinking styles. Participants take turns "wearing" the hats, expressing thoughts according to the assigned thinking style (facts, emotions, criticism, optimism, creativity, process control). This leads to a balanced approach to problem consideration and the development of multifaceted thinking.

- Role-playing Games Method

The essence of this method is to simulate real-life situations or tasks, allowing participants to take on different roles and perspectives. This helps develop problem-solving skills, empathy, and the ability to view situations from multiple angles, fostering creativity and innovative thinking.

Using simulation games to model real-life situations and find solutions. Participants take on roles, recreate scenarios, analyze possible actions and outcomes. As a result, we observe the development of decision-making skills, communication, and adaptation to changing conditions.

- Method of Dialogue and Discussions

Using discussions to talk through problems and generate ideas through interaction. Participants discuss the problem, express their thoughts, ask questions, and analyze different viewpoints. This develops critical thinking, the ability to argue their points, and teamwork skills.

Methods for developing creative abilities are an integral part of preparing future specialists. Their use allows for the development of creativity, critical thinking, and the ability to come up with unconventional solutions, which are key competencies in the modern world. Implementing innovative methods in the educational process, creating conditions for the active development of students' creative potential, and stimulating scientific research in this area are essential.

In modern psychology, creativity is often seen as the process of solving new and unusual problems that require original solutions. Ukrainian scientists such as V.O. Molyako, Ya.O. Ponomaryov, and V.M. Druzhinin have proposed various approaches to understanding and researching creative processes, which form the basis of methods for solving creative tasks.

The method of solving creative tasks is based on several key aspects, including empirical and theoretical approaches to creativity. Ya.O. Ponomaryov proposed a systemic-structural approach, which views creativity as a multi-stage process, each stage having its structural and functional characteristics.

The following stages of the creative process are distinguished:

1. Actualization of existing knowledge: at the initial stage, it is necessary to actualize knowledge that may be useful for understanding and solving a new task.
2. Direction of the search for a solution: determining the search directions and formulating possible approaches to solving the problem.
3. Invention of current technologies for solving: developing specific methods and tools for solving the problem.
4. Application of technologies in new conditions: using the developed methods in practical conditions.
5. Evaluation of the achieved result: analyzing and evaluating the effectiveness of the problem solution.

Creative thinking includes various cognitive processes such as divergent thinking, problem sensitivity, the ability to redefine concepts, and much more. Specifically, J. Guilford defined creativity through mental

abilities that ensure creative achievement, emphasizing the importance of divergent thinking, which allows generating many original ideas based on available information. The method of solving creative tasks is an important tool in developing creativity and the creative abilities of individuals. Its use promotes the formation of new approaches to solving complex problems, as well as the development of the intellectual and creative potential of future specialists. The prospects for applying this method in educational and professional environments are quite broad and deserve further research and improvement.

The "Brainstorming" method is one of the most common methods for generating ideas and solving creative tasks in group work. It was developed by Alex Osborn in 1941 and has since become a fundamental tool in many fields, from business to education. This method is based on the following main principles:

- No criticism: at the initial stage, any ideas are accepted without any criticism or evaluation.
- Quantity over quality: the main goal is to generate as many ideas as possible, regardless of their realism or logic.
- Encouraging unusual ideas: the more non-standard and unusual ideas, the better.
- Combination and improvement of ideas: participants are encouraged to combine and improve each other's ideas.

The brainstorming procedure is as follows: preparation is carried out first, defining the problem that needs to be solved. Next is the idea generation stage. Participants express their ideas, which are recorded without any criticism. After the idea generation session, all proposals are evaluated and the most promising ones are selected. The brainstorming method has several modifications, each adapted to certain needs and conditions:

- Written brainstorming

Participants write down their ideas on paper, which avoids the domination of more active participants.

- Electronic brainstorming

Using special programs to generate and process ideas online.

- Reverse brainstorming

Participants first consider all possible obstacles and difficulties and then propose ideas to overcome them.

The advantages of this method include stimulating creativity and innovation, encouraging teamwork and interaction, and quickly generating a large number of ideas. However, this method can be ineffective without a proper moderator. Also, the domination of some participants may suppress others, and it requires a lot of time to evaluate and select ideas.

The brainstorming method is a powerful tool for solving creative tasks and stimulating innovative thinking. Thanks to various modifications, this method can be adapted to different needs and conditions, providing effective idea generation in any field of activity.

The method of educational games is one of the effective means of developing the creative abilities of future specialists. It is based on the use of game situations to stimulate creative thinking, develop problem-solving skills, and increase motivation for learning.

The educational games method includes various game techniques and methods used in the educational process. They can be both individual and group, aimed at developing different aspects of the student's creative potential.

The educational games method is effective for several reasons:

- Motivation: the game format of learning increases students' interest in the material, making the learning process more engaging.
- Active participation: students are actively involved in the process, which contributes to better knowledge acquisition.
- Skill development: games promote the development of critical thinking, teamwork, and problem-solving skills.
- Stimulating creativity: game tasks often require unconventional approaches and generating new ideas.

Let's consider some examples of educational games.

Business Simulations simulate real business situations where students must make managerial decisions, analyze market conditions, and interact with other participants.

Case Studies involve analyzing specific situations (cases) that allow students to apply theoretical knowledge in practice, developing their own strategies for solving problems.

Interactive Role-Playing Games where students take on roles of different characters, helping to develop empathy, communication skills, and teamwork.

The educational games method is a powerful tool for developing

students' creative abilities. It makes the learning process more interesting and effective, promotes active student participation, and develops their critical thinking and creativity. Through this method, students not only gain knowledge but also learn to apply it in practice, which is important for their future professional activities.

Formative Experiment is one of the main methods in pedagogical and psychological research, allowing the assessment of the effectiveness of various educational influences and methods. This method enables scientists and practitioners to test hypotheses about the development of certain qualities or skills in subjects.

Main stages of the formative experiment:

- Defining the goal and hypothesis

The first step in conducting a formative experiment is to clearly define the research goal and formulate the hypotheses to be tested.

- Selecting methods and tools

Choosing appropriate methods and tools for conducting the experiment, including the development or adaptation of tests, questionnaires, and other diagnostic means.

- Conducting a pilot study

Conducting a preliminary, or pilot, study to check the validity and reliability of the chosen methods and tools.

Main stage of the experiment: implementing the main stage of the experiment, which involves actively intervening in the educational process to introduce new methods or programs.

Data analysis: collecting and analyzing the data obtained during the experiment, using statistical methods to assess the effectiveness of the interventions.

Formulating conclusions: Summarizing the results of the experiment and formulating conclusions about the effectiveness of the applied methods and their impact on the subjects.

Advantages of the formative experiment: it allows establishing causal relationships between educational influences and outcomes, provides an opportunity to test new pedagogical technologies in real educational conditions, and contributes to increasing the scientific validity of pedagogical research.

Disadvantages: it requires significant resources (time, materials, personnel) to conduct, demands high qualifications of researchers for proper

planning and implementation, and may encounter resistance from participants, affecting the results.

Examples of using the formative experiment: implementing methods for developing creativity in the educational process with subsequent evaluation of changes in students' creative thinking levels, testing new teaching technologies, such as interactive methods, to assess their impact on students' academic achievements.

The formative experiment is a powerful tool for researchers in the field of pedagogy and psychology. It allows not only testing the effectiveness of new methods but also drawing significant conclusions about their impact on personal development. The prospects for using this method lie in its further integration into educational practice to ensure continuous improvement of the learning process.

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PEDAGOGY OF VOCATIONAL EDUCATION: PROBLEMS AND PROSPECTS OF DEVELOPMENT IN MODERN CONDITIONS

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1. Formation of pedagogical skills of future specialists in vocational education.

One of the key patterns of development of modern society is the close relationship between socio-economic progress and continuous improvement of the vocational education system. A high level of education of employees is becoming a dominant value due to the widespread use of rapidly updated information technologies and intensive information exchange at the international, national and regional levels. These processes define specific requirements for the level of education and professional competence of specialists at various levels, including skilled workers.

Modern conditions are changing the main goals of education – more and more attention is being paid, along with the interests of the state, to meeting the needs of the individual for self-development, developing the ability of young professionals to analyze problems, put forward alternative solutions and develop criteria for their correctness. Significant changes in the education system, including the emergence of vocational schools of various levels – lyceumms, colleges, etc. – require a review of the existing theory and practice of vocational training of young people. The current stage of development of vocational education places increased demands on graduates, who must be equipped with the latest production methods and technologies, as well as have a creative approach.

Improving the vocational education system is particularly important in the context of its reform. The training of skilled workers should be ahead of existing production processes, and its main focus should be professional competence, which combines fundamental technical training with modern innovations, developed mental activity and the ability to improve and develop oneself in the course of professional activity.

The main problem in this area of education is not only the assimilation of a large and gradually growing amount of knowledge or orientation in the

flow of information, but also the acquisition, creation and production of knowledge that is necessary for the individual. Such education becomes a way of information exchange that takes place in every act of a person's life throughout his or her life.

It is possible to improve the training of skilled workers by strengthening the methodological component of vocational education, introducing the latest theories, concepts and teaching methods, and restructuring the content of vocational education in the direction of integrating specialized and general technical knowledge. These contradictions have led to the need to change the content of general technical and special subjects aimed at improving the level of professional training of graduates, developing their need to acquire new knowledge, abilities, professional mobility and competitiveness in the modern labor market.

The profession of a vocational school teacher is one of the most creative and challenging professions that combines science and art. This profession is related to the work of a writer (creativity in preparing material), director and stage manager (creation of an idea and its realization), actor (in pedagogical activity, the teacher's personality is the instrument), educator, psychologist and scientist. The activity of a teacher is of high social significance and occupies one of the central places in state-building, formation of national consciousness and spiritual culture of Ukrainian society. The work of a teacher in a vocational education institution is a conscious, appropriate activity for the education, upbringing and development of students. It is twofold - special and social and educational, the most important prerequisites for the effectiveness of pedagogical work. Both of these prerequisites should be considered in an organic unity. The special characteristic of teaching reflects the connection with the social division of labor. The social and educational aspect of teaching is related to the ideological principles of society.

The professional activity of a teacher in a higher education institution has its own specifics, which are mainly as follows:

1. Physical and intellectual strengths and abilities of the teacher: A teacher must possess certain physical and intellectual abilities that allow him/her to effectively perform his/her activities in the education and training of students. Especially important are organizational skills that help in the creation and implementation of the educational process.

2. Originality of the object of pedagogical work: Students, as objects of pedagogical activity, are also its subjects. This means that the activity of students in the learning process largely depends on the level of their organizational knowledge and skills that they acquire during their studies.

3. The means of labor of the teacher: A significant part of the teacher's means of labor is spiritual. This includes methods and techniques that contribute to the development of intellectual and creative abilities of students, as well as the formation of their personality.

4. Specificity of the relationship between the three subsystems: The professional activity of a teacher includes a set of intellectual and physical forces of the teacher, certain data of the object of work (i.e. students), and a set of means and structure of activity. The interaction of these three subsystems creates a unique environment in which the educational process is carried out.

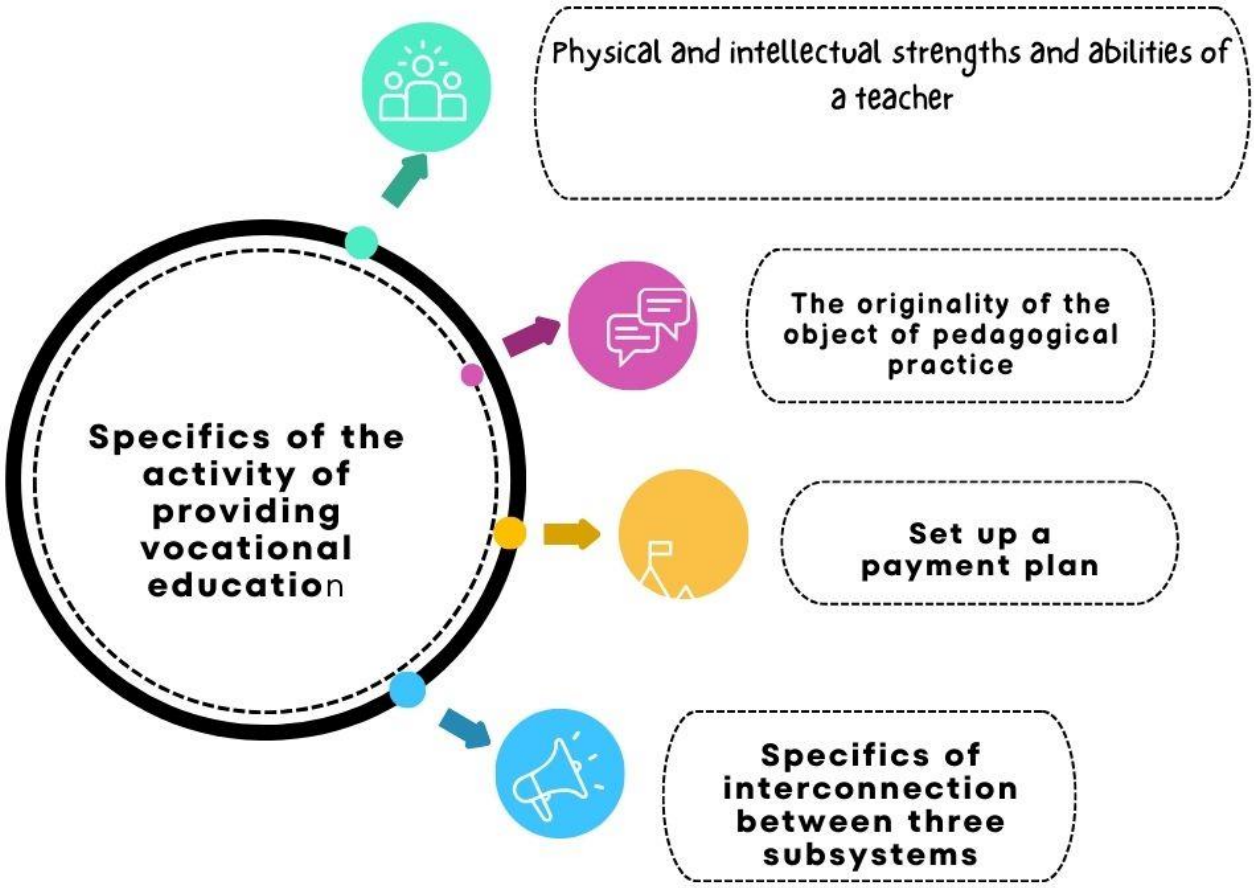

Fig.1. Specifics of the activity of providing vocational educational

That is, the work of a university teacher is a highly skilled mental activity aimed at training and educating qualified specialists for all sectors of the national economy, the intellectual elite of society and the Ukrainian intelligentsia. This profession organically combines the knowledge and erudition of a scientist with the art of a teacher, high culture and intellectual and moral maturity, awareness of duty and a sense of responsibility.

A modern teacher must be able to learn and teach students to absorb knowledge, critically comprehend the information they receive, and strive for self-improvement, research, and creative activity. We are talking about the professional skills of a higher education teacher.

The system of training vocational education specialists does not meet the current needs of society. Many specialists working as teachers do not have the necessary general theoretical training and do not have special knowledge of pedagogy and psychology.

Pedagogical excellence is seen as a high level of mastery of pedagogical activity, which is achieved on the basis of deep professional and general knowledge, certain experience, skills, abilities and creativity that ensure its success. The achievement of pedagogical excellence is conditioned by the presence of a teacher's complex of professional knowledge, broad outlook, formed pedagogical consciousness, professionally significant personal qualities and extensive work experience.

Pedagogical mastery is a complex, dynamic and integrated personal formation, which includes a strong desire to work in the field of education, special knowledge, skills and abilities, as well as a set of individual mental and characteristic features that ensure high efficiency of professional activity. Thus, the indicators of professional readiness of a graduate of a higher education institution, turning into professional competence, become the basis for the development of pedagogical skills of a higher education teacher.

Ways to develop pedagogical skills include focusing on anticipating possible quantitative and qualitative socio-economic and cultural changes in society, taking into account trends in educational tasks, as well as understanding and adapting the interrelated processes of globalization and simultaneous regionalization of educational systems. An important aspect is also to ensure the formation of the individual as a subject of self-determination based on personality-oriented and competency-based approaches.

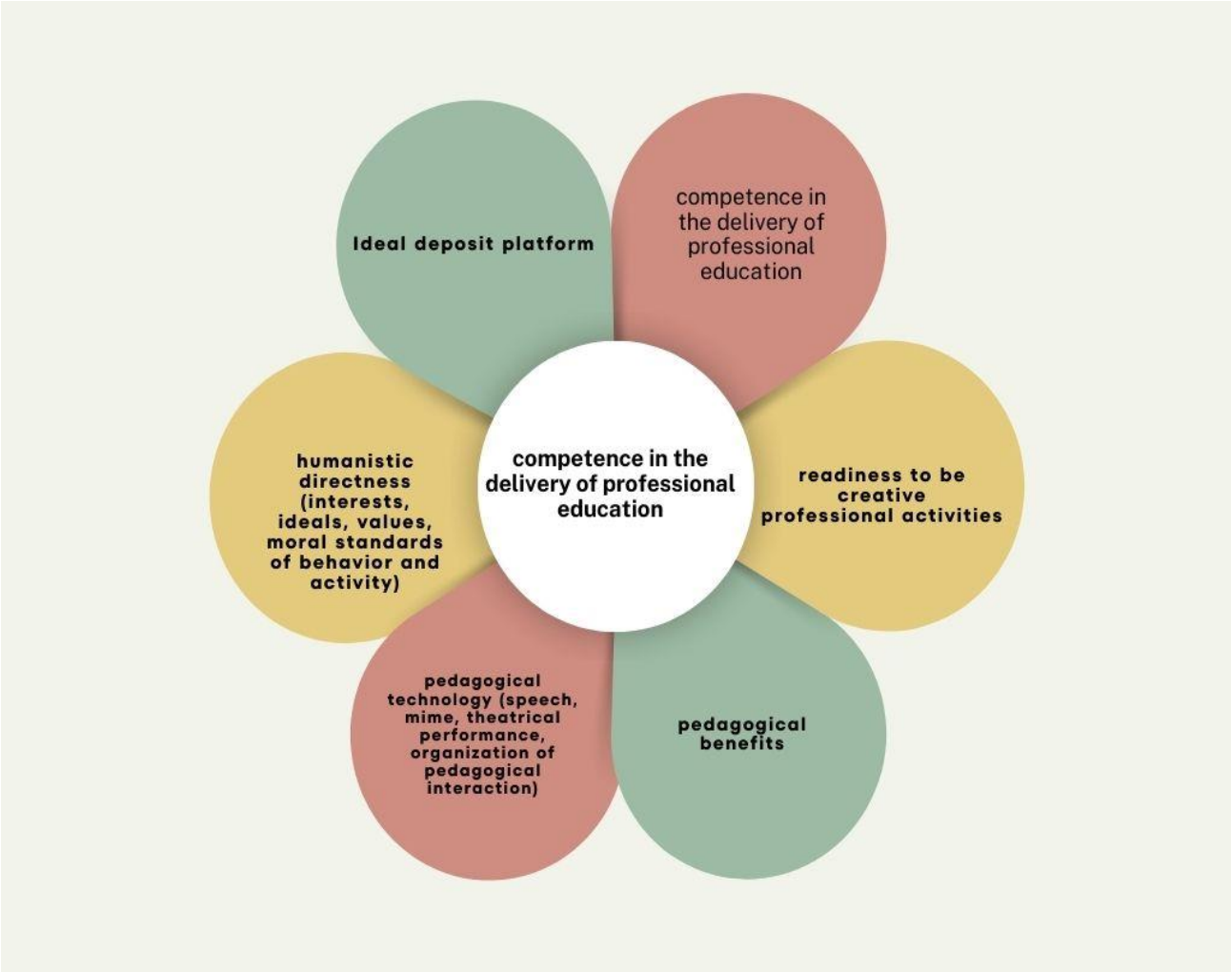

Fig.2. Competence in the delivery of professional education

This process should be implemented on the basis of "open education", which promotes the development of professional knowledge with the help of modern world approaches to the formation of basic knowledge. This ensures the implementation of both joint and individual development trajectories, and focuses on the reconstruction of target, content, and procedural and activity components of teacher education. The main goal is to maximize the development of the teacher's ability to self-identify, personal motivated reflective self-realization in a dynamic socio-cultural environment.

Professional growth is a complex and dynamic process that should be viewed as a comprehensive mechanism that focuses on achieving clearly defined goals and objectives. An effective model for the development of this process is based on scientific principles and includes the following components: goal, objectives, content, types of pedagogical activities, organizational forms, methods and means, as well as a feedback mechanism

[1].

Pedagogical skills are developed through the improvement of its main components, such as pedagogical abilities, professional qualities, professional competencies, and readiness for creative work, experience and pedagogical techniques.

The process of improving pedagogical skills is realized through various forms of work both in and out of the classroom, as part of the general educational activities of a higher education institution. The disclosure of professional and pedagogical potential depends on the need for self-realization, active cognitive interest and self-identification.

The most effective methods of developing teachers' pedagogical skills are:

- Discussion of open classes
- Mutual attendance of lectures and seminars
- Discussions and trainings
- Roundtables and dialogues-disputes
- Seminars and workshops
- Discussion of achievements in psychological and pedagogical theory and practice, as well as modern educational technologies
- Varieties of games
- Development and discussion of author's programs
- Scientific and practical conferences
- Methodological seminars

Effective forms of organizing work with teachers in the experimental group include systematic counseling, demonstration of pedagogical techniques, training exercises, laboratory workshops, master classes, and creative groups.

The integrated use of active forms and methods helps to consolidate theoretical knowledge, provide teachers with the necessary methodological tools to solve modern educational problems, develop their ability to reflect and use the information received in new conditions. It also helped to improve their intellectual, ideological and communication skills.

2. Innovative teaching methods in the training of vocational education specialists.

The global changes taking place in the formation of a new automated environment open up unprecedented opportunities for personal

development and more effective solution of professional, social and everyday tasks. However, only those people who have the appropriate knowledge and skills to navigate the new information environment and effectively use its potential will be able to take advantage of these opportunities.

The task of the modern educational system is to reduce inequality in access to information resources, which is achieved by raising the level of information culture of citizens. Information components should become dominant in educational programs, as future specialists will live and work in the information society, where fundamental knowledge of information processes and the latest information technologies will play a significant role.

The processes of change taking place in society, nature and technology are so large-scale that they are called the "information revolution". This revolution and the formation of a new type of society – the information society – put information and knowledge at the forefront. Young people must strive for new knowledge and information in order to adapt to rapidly changing requirements and technologies of training, to update their professional knowledge and to improve their competence throughout their lives. The educational system must meet these requirements by forming an adequate organizational structure and implementing the principle of "lifelong learning". Educational institutions in Ukraine are facing the challenge of adapting the educational process to modern requirements, where informatization of society, access to the Internet and automation of life play a significant role [2].

Innovation processes in the education system are aimed at creating new stages in the interaction and development of scientific and pedagogical creativity, as well as in the application of their results. The main trend is to reduce the gap between the processes of creating pedagogical innovations and their perception, adequate evaluation, development and use. This also includes overcoming contradictions between the spontaneity of these processes and the need for their conscious management.

Educational innovations can be manifested in various aspects: in the content, methods, techniques and forms of educational activities and personal development, in methods and technologies, as well as in the formation and organization of management structures of educational institutions. They can affect the means of teaching, upbringing and social

services in education, which significantly improves the quality, efficiency and effectiveness of the educational process.

Educational innovation is considered as a separate branch of scientific knowledge and a subject of methodological research, studying the scientific problems of innovation processes in the modern philosophy of education and upbringing. Thus, educational innovation involves an interdisciplinary synthesis of sociological, didactic, psychological, acmeological, economic and other tasks. It reveals the deep processes of creating and applying innovations in the education system, taking into account the peculiarities associated with the participants in this process and the subjects of developmental interaction [3].

The main features of educational innovations are:

 Targeted changes. They introduce new stable elements (innovations) in the field of education that contribute to the transition of the system from one quality state to another.

 Specific features: These changes are related to socio-psychological and other aspects of pedagogical activity.

 Initiation at different levels: Innovative changes can be initiated at any level of the educational system.

 Participation of all stakeholders: Innovative changes should take place in the activities and thinking of all participants in the educational process.

 Continuity of processes: Innovation processes in education should be continuous and aimed at continuous improvement of the existing system.

 Quality management mechanisms: In order to ensure continuous innovative renewal of the educational sector, appropriate mechanisms for managing the quality of education should be implemented.

 Receptivity to innovation: The effectiveness of the implementation of a particular innovation largely depends on the level of receptivity to innovative changes in the system and the availability of real opportunities for the implementation of innovations (i.e., implementability).

The classification of innovations in education is a rather complicated methodological task due to the complexity of the concepts of “innovation” and “innovation in education”, which also makes it difficult to unambiguously define the criterion for classifying innovations [4]. Thus, the technological approach divides innovations into productive and procedural ones. The former in volve fundamentally new products, and the latter

involve new methods of organizing production (new technologies). In addition, innovations are classified by the level of innovation change.

There are eight ranks (orders) of innovations in education:

- Zero-order innovations. They involve the practical regeneration of the primary properties of the system (reproduction of the traditional educational system or its element).

- First-order innovations. They are characterized by quantitative changes in the system while maintaining its quality.

- Second-order innovations. They are a regrouping of system elements and organizational changes (for example, a new combination of known pedagogical tools, a change in the sequence, rules for their use, etc.)

- Third-order innovations. They are characterized by adaptive changes in the educational system in new conditions without going beyond the old model of education.

- Fourth-order innovations. They contain a new solution (most often, simple qualitative changes in individual components of the educational system that provide some expansion of its functionality).

- Innovations of the fifth order: Initiate the creation of "new generation" educational systems (change of all or most of the primary properties of the system).

- Sixth-order innovations. As a result, educational systems of a new look are created with a qualitative change in the functional properties of the system while maintaining the system-forming functional principle.

- Innovations of the seventh order. It is a higher, fundamental change in educational systems, during which the basic functional principle of the system changes [5].

A classic example of the classification of educational innovations is the typology, which systematizes innovations according to the following criteria: 1) type of innovation; 2) mechanism of implementation of the innovation process; 3) features of the innovation process.

According to the type of innovation, they are divided into material and technical and social, which include economic, organizational and managerial, social and managerial, legal and pedagogical innovations. An important characteristic of innovations is their complexity, which manifests itself in two aspects:

1) complexity of innovation (introduction of complex changes in the environment or system);

2) complexity of implementation (innovative nature of the process of innovation implementation).

The classification of innovations also takes into account their orientation:

1) product or subject matter;

2) supporting.

According to the “innovative potential”, educational innovations are divided into:

1) radical or basic (fundamentally new);

2) combinatorial (various combinations of components)

3) modified (improvement of basic systems, structures, forms, etc.).

The next classification criterion is continuity, which divides educational innovations into:

1) substitutive (an innovation that replaces an old analog)

2) abolishing (rejection of previous developments)

3) reverse (reuse due to the failure of the innovation);

4) discovering (completely new, without analogues);

5) retro-innovations (modern reproduction of outdated innovations to improve a process or product).

In terms of volume, educational innovations are divided into point, systemic, and strategic innovations. The first two parameters characterize the scope, and strategic innovations include: the scale of the impact of the innovation and the systematic nature of its implementation, based on relevant forecasts. In terms of the range of implementation, educational innovations are defined as single (implemented in one place to solve a single problem) and diffuse (implemented on a large scale: industry, district, system, region, etc.) [6].

Educational innovations are newly created, improved or implemented educational, didactic, educational and management systems, as well as their components, which significantly improve the results of educational activities.

Priority educational innovations in higher education institutions (HEIs) include:

 introduction of modular learning and a rating system for knowledge control (credit-modular system);

 distance learning system;

 computerization of libraries with the use of electronic catalog programs and creation of a fund of electronic educational and teaching materials;

 electronic system for managing the activities of the educational institution and the educational process.

The educational process should use a variety of innovative pedagogical methods based on interactivity and bringing students as close as possible to real professional activities:

- simulation technologies (game and discussion forms of organization);
- “case-method” technology (maximum approximation to reality);
- video training methodology (maximum approximation to reality);
- computer modeling;
- interactive technologies;
- technologies of collective group learning;
- technologies of situational modeling;
- technologies for processing discussion issues;
- project technology;
- information technologies;
- technologies of differentiated learning;
- text-centered learning technology.

The introduction of various innovative forms of organizing the educational process and teaching technologies is inextricably linked to the creation of innovative tools for the creative activity of students and teachers, i.e., material and technical support. Computer classrooms with Internet access play a special role in this, since the use of computers in teaching, research, control and self-control is extremely important in the context of intensive innovative teaching technologies.

The basis of the innovative activity of a modern teacher is the formation of an innovative programmatic methodological complex in the discipline. Along with the software and content of the disciplines, the use of information tools and their didactic properties comes to the fore. This involves visual and figurative presentation of information, creation of a video library to illustrate information material: lecture notes, electronic lecture notes that allow combining a slide show of text and graphic support (photos, diagrams, drawings) with computer animation of text, display of

documentary records. It combines technical capabilities - computer and video - with live communication between the lecturer and the audience.

This suggests that innovation is a key form of educational development, and the management of the innovation process, which includes creating conditions for its reproduction, is the main mechanism that determines its quality and the overall quality of education.

3. Methodological Aspects of Vocational Pedagogy as a Scientific Component in the Training of Vocational Education Specialists

Modern professional teacher education is undergoing radical changes due to social transformations in Ukraine. Adaptation of higher education to the criteria of the European Union requires the development of new approaches to the professional training of future specialists in the field of education. This need is driven by significant changes in the spiritual space of society and education, the transition from traditional to professional education based on the latest educational technologies, methodological principles and modern interactive media and communication. There is a growing demand for specialists who, in addition to knowledge, skills and abilities, possess social and professional qualities and are competitive in the modern labor market. The process of reforming modern education actualizes the research of Ukrainian scientists in the field of vocational teacher education.

Among the independent disciplines, pedagogy stands out as a science that studies human upbringing, education and training. It reveals the essence, goals, objectives and patterns of education, analyzes its role in the life of society and personal development, and studies the processes of education and training [7,8].

The subject of pedagogy is education as a real holistic process that is purposefully organized in special social institutions, such as the family, educational and cultural institutions.

On the basis of this conceptual vision of the subject of pedagogy, researchers substantiate the theoretical and practical functions of pedagogy. The theoretical function is realized at three levels:

1. Descriptive or explanatory - the study of advanced or innovative pedagogical experience.

2. Diagnostic - identifying the state of pedagogical phenomena, the success or effectiveness of the teacher and students, establishing the conditions and causes of this activity.

3. Predictive - experimental research of pedagogical activity and building models of transformation of reality on their basis.

As for the technological function of pedagogy, it is also realized at three levels: projective, transformative, reflective and corrective. The last level involves assessing the impact of research results on the practice of teaching and upbringing with subsequent correction based on the interaction of theory and practice.

The State National Program "Education" ("Ukraine of the XXI Century") emphasizes that one of the principles of its implementation is continuity, which provides an opportunity for continuous deepening of general and professional training, achieving integrity and continuity in education and upbringing, as well as transforming education into a process that lasts throughout a person's life. The main focus of the program is to create conditions for the training of a new generation of teaching staff capable of implementing a personally oriented system of education and upbringing based on humanistic pedagogy, increasing their professionalism and skills [9].

The National Doctrine of Education Development of Ukraine emphasizes that the training of pedagogical specialists and their professional development are key conditions for the modernization of education. To support and increase their responsibility for the quality of their professional activities, the state ensures

- development and improvement of the regulatory framework for the professional activity of pedagogical specialists;
- forecasting and meeting the needs of society and the labor market for these specialists;
- development of a competitive system of educational institutions for training, retraining and advanced training of pedagogical specialists;
- development and implementation of state standards of pedagogical education of different educational and qualification levels and state standards of postgraduate education;
- mastering of modern information technologies by pedagogical specialists;

- periodic updating and mutual coordination of the content of training, retraining and advanced training of pedagogical specialists;
- introduction of a system of targeted state funding for the training of pedagogical specialists and their professional development;
- improvement of the system of motivation for professional growth and improvement of the professional level of pedagogical specialists, including the possibility of learning foreign languages and other activities.

These factors are extremely important for vocational education, which is guided by the world's innovative, humanistic and progressive models. It is important to note that the main goal of the vocational education system is to train qualified specialists by creating conditions for the development and self-realization of each individual.

Modern labor market requirements and socio-political needs determine the need for the realization of a specialist as a person. To ensure a high level of competitiveness of future specialists in the pedagogical field, it is important to introduce innovative approaches to the process of training specialists in higher education and define professional competencies.

There are active discussions among scholars on the substantiation of the set of competencies of a teacher in the structure of standards of her professional training and activity. L. Pukhovska emphasizes that competencies should be formed at a high level and reflected in the professional characteristics of a teacher at different stages of his or her professional career. At the same time, these competencies should be based on the principles of the relationship between theory and practice, and should focus on developing the ability to critically reflect on one's own pedagogical experience and the experience of other countries.

The content of education is the main tool for transforming national education systems, including pedagogical education, with an emphasis on competency-based principles. There is a shift away from the traditional structuring of content based on the subject principle, which implies that the structure of education corresponds to the structures of scientific knowledge. In the competency-based approach, the content of education is considered not through the number of subjects (the so-called “input regulation”), but through the definition of results (“output regulation”) to be achieved at the national level [10].

Thus, changes in the content of training are aimed at constructive professional activity, improving the quality and fundamentalization of the education of the future specialist's personality.

To ensure the interaction between the subject of learning and the educational system that prepares a future specialist, professional teacher education is closely related to labor pedagogy. In our opinion, labor pedagogy is the creative use by a specialist of a set of scientific and theoretical knowledge, skills and abilities acquired during professional training and practice. It involves adaptation to professional activities and improvement of professional competencies in accordance with the current requirements of the labor market.

Important are the scientific studies of academician N. Nychkalo [9], which are devoted to the problems of vocational education development from the perspective of labor pedagogy.

These works convincingly demonstrate professional scientific interest in the development of pedagogical subdisciplines and their impact on improving, updating and diversifying approaches to vocational teacher education.

Labor pedagogy and vocational pedagogy substantiate the following principles of vocational education:

1. Proactive nature of vocational training: focus on future labor market needs.
2. Continuity: ensuring continuous learning throughout life.
3. Fundamentalization: providing in-depth theoretical knowledge.
4. Integration of vocational education, science and production: creation of a single educational, scientific and production space.
5. Equal access to quality vocational education for different categories of the population: ensuring fair conditions for all.
6. Flexibility and interconnection of the vocational training process with the restructuring and further development of the economy and employment, development of different forms of ownership: adaptation to changes in the economy.
7. Diversification: a variety of forms and methods of training.
8. Regionalization of vocational education: taking into account the specifics and needs of the regions.
9. Combination of general education and vocational training: ensuring the comprehensive development of the individual.

10. Unity of vocational training and education: development of professional and moral qualities.

11. Ecologization: inclusion of environmental knowledge and practices in the educational process.

12. Variability: providing students with a choice.

13. Individualization and differentiation: taking into account the individual characteristics and needs of students.

The following methodological approaches are usually successfully applied in pedagogy: systemic, synergistic, personal, activity, dialogic, cultural, axiological, competence, and praxeological. The methodological basis of most modern pedagogical research is the philosophical doctrine of the integrity of systemic connections and relations aimed at the formation and development of the individual.

The systematic approach in science and practice is an important tool for analyzing and organizing knowledge about complex objects and phenomena. Here are the main aspects of the systems approach:

- ❖ Consideration of the object as a system. The systemic approach involves studying an object as a single whole, consisting of elements that interact with each other. This allows you to better understand its functioning and interconnections.
- ❖ Identification and classification of elements. It is important to identify the elements of the system, classify them, and determine how they interact. This helps to identify key components and their role in the overall functioning of the system.
- ❖ Analysis of connections and interactions. The systemic approach allows you to identify the system-forming relationships that are critical to the organization of the system. It also includes the analysis of cause-and-effect relationships and hidden dependencies both within the system and in interaction with the supersystem.
- ❖ Consideration of external and internal influences. Both external factors affecting the system (supersystem) and internal interactions between subsystems are assessed.
- ❖ Organization of information and conclusions. The systemic approach helps to organize information about the system, identify key patterns, and draw reasonable conclusions about its functioning.

This approach is extremely useful for solving complex problems and for systematizing knowledge related to various aspects of activity and organization in many areas, including pedagogy.

The synergistic approach expands the traditional understanding of the systems approach by focusing on the dynamics and properties of the system that are formed as a result of the interaction of its parts. The main aspects of synergetics in the context of the pedagogical process include:

- Non-linearity: The synergistic approach emphasizes that the development of a system is not straightforward or predictable. In the pedagogical process, this means that outcomes are not always a linear function of inputs; instead, development can go in different directions and have unpredictable outcomes.

- Coherence: Coherence between different aspects of system development is important to ensure that they are mutually reinforcing. In a teacher education institution, this can be manifested through the integration of curricula, research projects, and teaching methods that work together to improve the quality of education.

- Openness: Openness to external changes and new challenges is a key characteristic of synergy. The pedagogical process must be able to adapt to new ideas, technologies, and social conditions to remain relevant and effective.

- Self-organization: Synergetics emphasizes the ability of a system to self-organize and self-construct. In the context of higher education, this can mean that the learning process and structure can evolve in response to internal and external needs and challenges.

- Synergistic effect: The combination of different elements and approaches can lead to significant improvements in the quality of professional training. In the pedagogical process, this can be manifested in the form of more effective learning and student development through the integration of new methods and technologies.

- Interaction between teacher and student: Interaction between a teacher and a student is an important factor in the development of both parties. Openness to new ideas, changes, and willingness to cooperate contribute to the development and adaptation of both the teacher and the student.

The synergistic approach helps to create educational systems that are dynamic, adaptive and capable of continuous improvement, which is especially important in the rapidly changing world of education.

The activity-based approach, bringing its own characteristics to the goals and objectives of the pedagogical process, restructures mainly its procedural and technological side in such a way that the subjects of the educational process master the activity in its holistic view.

The axiological approach in professional teacher education emphasizes the importance of spiritual values in the process of education and upbringing. This approach focuses on how values influence the activities of teachers and students and has several key aspects:

1. Value-motivated learning. The axiological approach recognizes that each participant in the educational process is an active subject motivated by certain values. This implies that learning should be focused on the development and maintenance of these values.
2. Subject-subject relations. Emphasis on the interaction between the teacher and the student as equal partners in the learning process. This means that the relationship should be built on mutual respect and understanding, where each party has its own value and role.
3. Favorable psychological climate. Creating a positive learning environment where the values and motivations of the participants in the educational process are taken into account and supported. This includes emotional support, understanding and recognition of the personal needs and values of each participant.
4. Formation of spiritual values. The pedagogical process should be aimed at the formation and development of spiritual and moral values in students. This may include ethical, cultural and social aspects of education that help students become conscious and responsible citizens.
5. Humanistic aspect. The axiological approach is part of humanistic pedagogy, which emphasizes the importance of personal development, values and motivation. The humanistic approach supports the idea that education should be not only about the transfer of knowledge, but also about the formation and support of values that define a person.

Implementation of the axiological approach in vocational teacher education helps to create an educational process focused on the development of values and motives, which is the basis for successful training and education of future professionals.

The axiological approach in vocational teacher education defines its priority task in revealing values as essential forces of personality. It focuses on the intellectual, ethical and creative potential of the individual.

This approach emphasizes the importance of developing an individual's ability to navigate freely in complex social and professional situations, as well as to choose and implement innovative processes.

The personal approach requires recognition of the uniqueness of the individual, his or her intellectual and ethical freedom, and the right to respect. The activity-based approach organizes socially and ethically fulfilling life activities. The dialogic approach is based on the belief in the positive potential of a person, his or her unlimited creative capabilities for continuous development and self-improvement. In combination with the personal and activity approaches, it is the essence of the methodology of humanistic pedagogy.

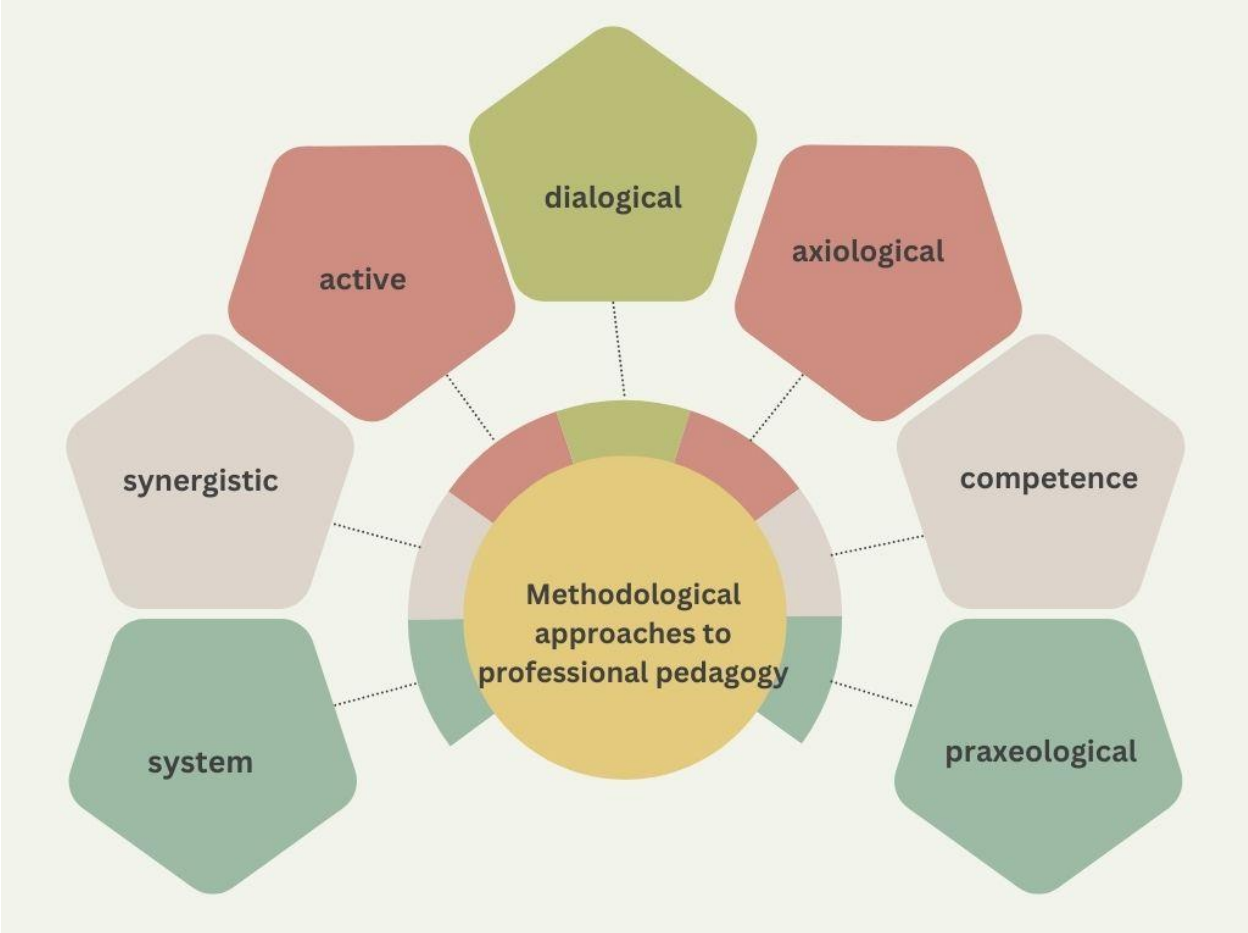

Fig.3. Methodological approaches to professional pedagogy

The cultural approach sets a social and humanistic program of activity, and the anthropological approach means the systematic use of data from all human sciences as a subject of education. The axiological approach points

to the dependence of educational outcomes on a clear definition of the axiology of the transformations taking place in the country and in the world, and on the identification of the value aspect of education.

The synergistic approach emphasizes the interaction of system elements that lead to new qualities of the system as a whole. The competence approach involves the formation of professional competence in a specialist as the ability to successfully solve the tasks of professional activity. The praxeological approach takes into account the needs of practice and is aimed at meeting the practical needs of a person receiving education.

Each of these approaches is extremely valuable and productive in solving pedagogical problems. However, agreeing with academician I. Zyazyun, we consider it expedient to adhere to the methodological principle of integrity, the so-called holistic approach, which is often referred to by researchers as the methodological basis of the study. A holistic approach, as an integration of different methodological approaches, is able to reflect the holistic nature of a complex pedagogical process, which is the educational process in a pedagogical higher education institution [10].

Based on the above material, the following conclusions can be drawn:

Education should facilitate Ukraine's integration into global economic and cultural structures. This requires scientific and theoretical substantiation of progressive pedagogical technologies and the use of various methodological approaches to organize vocational and pedagogical education.

The main directions of education development are systemic, synergetic, personal, activity, cultural, competence and praxeological approaches. Each of these approaches plays an important role in shaping the modern educational system.

Pedagogical innovations and the realization of the teacher's creative potential are essential elements of the development of professional teacher education. They lead to the technological reorganization of the educational process, which, in turn, contributes to improving the quality of education and training of future professionals.

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ENTOMOLOGICAL SCIENTIFIC SCHOOL OF KHARKIV NATIONAL AGRICULTURAL UNIVERSITY NAMED AFTER V.V. DOKUCHAIEV

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A historical essay on the development of agricultural entomology in Ukraine since the nineteenth century up to the present days is presented. The most prominent stages and events on the way of the entomology development in the agrarian sector are highlighted. The prominent personalities that influenced the development of the world and national science on crops protection against the pests are mentioned. The role of the Entomological School of Kharkiv National Agrarian University named after V.V. Dokuchaiev as one of the oldest in Ukraine and Europe is defined separately. The main achievements of the outstanding entomologists of Kharkiv National Agrarian University named after V.V. Dokuchaiev such as I.K. Tarnani, V.G. Averin, O.O. Mihulin, B.M. Lytvynov, O.V. Zakharenko, Ye.M. Biletskyi and others are pointed out. The present state of the development of agricultural entomology in Ukraine and in Kharkiv National Agrarian University named after V.V. Dokuchaiev is described.

***Key words**: agricultural entomology, plants protection, history of development, scientific schools, Ukraine, Kharkiv, Kharkiv National Agrarian University named after V.V. Dokuchaiev.*

Introduction. Protection of plants against pests is an essential reserve for obtaining the additional production of better quality. The most cost-effective branch of agricultural production is the payback of the expended funds. For example, in the United States, every dollar lost in chemical protection provides additional products for almost $ 4 (Fedorenko et al., 2013). In the system of protective measures in world agriculture, the chemical method prevails now. For example, in the United States, plant production uses about 4 billion pesticides per year, and 2 billion dollars are

used in France. However, the intensive and widespread use of chemical plant protection products along with the high economic effect also causes various side effects associated with the environmental pollution, deterioration of the people's health, the emergence of pesticide-resistant forms of harmful organisms, etc. This, in turn, requires additional funds to minimize these negative consequences.

In this connection, the problems of avoiding pest and environmental damage to plant products should be solved on the basis of the concept of integrated plant protection, according to which the greatest attention should be paid to natural factors of containment of the reproduction and development of harmful organisms. In particular, various alternative methods of plant protection such as the use of transgenic plants, biological control of pests, diseases and weeds, agro-technical method, etc. are of great importance.

According to the data of 1980, in Ukraine the pesticide load per one hectare of arable land and perennial plantations amounted to 2.04 kg of active substance and the pesticides only in agrarian production were used annually for the amount of about 342 million USA dollars. At present the volumes of pesticides sales in the country amount to only 150-170 million dollars per year, and in general the level of their use for plant protection is 20-30% of the minimum requirement. There is an extremely unsatisfactory provision of grain crops and sugar beets with chemical means of protection, in particular with the insecticides, which leads to significant losses of crop yields and deterioration of its quality. In this situation it is important to maximize the possibilities of existing methods and measures for the protection of plants, and, first of all it should be the organizational and economic, agro-technical, biological, and other methods of protection.

The great importance in the construction of ecologically-oriented and integrated systems for protecting crops from pests belongs to agricultural entomology (Fedorenko et al., 2013).

Entomology (from the Greek words *entomon*- insect and *logos* – study) is the science about insects. In the XVIIIth centuries it was singled out from Zoology as a separate branch of knowledge. According to the diverse values of insects in nature and human activity, now this science is divided into a number of disciplines which task is to develop scientific methods for protecting plants, humans and animals from harmful insects (Litvinov et al., 2005, Fedorenko et al., 2013).

The main task of agricultural entomology is to protect plants in order to reduce or prevent crops losses because of harmful animal organisms, especially insects, both during the growing season and during storage. The nature of the damage and the size of the yield shortage are connected not only with the behavior of the pests, but also with the corresponding reaction of the plant to the damage caused by its varietal characteristics, conditions of management, etc.

Materials and methods of the researches. As a result of a retrospective analysis of available literary sources, the authors made a historical review of the development of agricultural ectomology in Ukraine in the XIX-XXI centuries and the role of the entomological school of Kharkiv National Agrarian University named after V. V. Dokuchaiev.

The Results. ***The history of agricultural entomology development in Ukraine.*** The varieties of physical and geographic conditions, as well as the large set of cultivated crops and natural vegetation determine the number of insects that damage the crops, gardens, forests and field protecting forest shelter-belts. More than 3000 species of insects, damaging useful plants are registered in the territory of Ukraine. Among them 680 species cause significant damage, 480 species are pests of agricultural crops and 200 species cause damage to forest plantations (Litvinov et al., 2005, Fedorenko et al., 2013).

The massive reproduction of insect pests has been observed in Ukraine since 1008 AD (webworm beetle in 1686 and winter moth in 1814). The massive proliferation of insect pests has always been a surprise to the farmers. The need to find measures to control pests and the desire of man to knowledge became the source of the origin of scientific entomology (Beletskij, 2006, Beletskij & Stankevich, 2018).

However, only in the nineteenth century Entomology was formed into an independent branch of knowledge. Even then, the vast majority of scientists understood that the effective measures to protect a given crop from pests could only be developed on the basis of knowledge of the biology and ecology of insects and taking into account the accumulated theoretical knowledge of the science.

The history of plant protection science is closely linked to the diverse role of insects and other animals in nature and human life and needs to be

studied in detail. Ukrainian researchers also rightfully belong to the cohort of prominent plant protection scientists in the world.

A great event in organizing and systematizing scientific researches in this area was the creation of the Russian Entomological Society in 1859, which was later transformed into the All-Union Entomological Society, and in 1949 the Ukrainian Entomological Society was created as a part of it. The members of the association were such prominent and well-known scholars as P.P. Semenov-Tian-Shanskyi, M.O. Kholodkovskyi, J.A. Porchynskyi, M.M. Rymskyi-Korsakov, F.N. Keppen, M.M. Kulahin, M.V. Kyrdiumov, A.P. Semenov-Tian-Shanskyi, M.Ya. Kuznetsov, G.A. Kozhevnykov, O.G. Lebiedev, V.P. Pospelov, O.V. Znamenskyi, V.G. Averin, Ye.V. Zverezomb-Zubovskyi, M.A. Telenha, O.J. Petrukha, M.P. Diadechko, V.I. Husev, M.M. Synytskyi, O.P. Cryshtal, S.I. Medvedev, I.D. Bilanovskyi, B.I. Belskyi, J.J. Korab, Z.S. Golovianko, B.S. Denysievskyi, A.I. Zrazhevskyi, G.N. Zhygaiev, O.V. Zahovora, Ye.M. Kititsyn, G.M. Kolobova, Ye.V. Ktokov, O.O. Mihulin, M.D. Taranukha, D.F. Rudnev, P.P. Savkovskyi, P.O. Svyrydenko, Ye.M. Savchenko, Z.M. Savitska, G.Yu. Sobol, I.K. Zahaikevych, V.G. Puchkov, V.P. Vasyliev, I.Z. Livshyts, M.M. Palii, A.K. Olkhovska-Burkova, B.A. Areshnikov, P.I. Sussidko, V.M. Yermolenko, V.G. Dolin, Yu.P. Nekrutenko, V.G. Nadvornyi, V.S. Shelestova, V.M. Stovbchatyi, B.M. Lytvynov and many others (Litvinov et al., 2005, Fedorenko et al., 2013).

In the middle of the 70s of the nineteenth century the southern steppe zone of Ukraine was covered by the massive reproduction of the locust, winter moth, webworm beetle, corn ground beetles, scarab beetles, sun pests and other pests. The damages done to the agriculture by harmful insects were very large and, in general, significantly exceeded the losses from any group of harmful animals. These circumstances forced the Zemstva to seek practical help from the universities and the Department of Arable Farming. The first scientific centers were created in Odessa and Kharkiv and entomological commissions were established, their task was to study biology and ecology of insects and search for the measures to control them.

In 1867–1887 the famous biologist I.I. Mechnykov worked in Odessa. As a progressive scientist, he could not be indifferent to the national disaster. In that period I.I. Mechnykov carried out the fundamental research in the field of microbiological method for controlling scarab beetles. Subsequently, the results of these studies became the basis for the

development of microbiological protection of plants from harmful organisms. The significant contribution to the entomological science at that time was made by the first provincial entomologists S.O. Mokrzhetskyi (the Crimea), I.K. Pachoskyi (Kherson), and P.A. Zabarynskyi (Odessa).

In 1878 the first Zemstvo entomological commission was created in Kharkiv and the second such commission was created in Odessa. Their task was to observe the plants pests and develop the measures to protect crops from them. In the period from 1881 to 1890 there were nine congresses of the commissions. The main attention was paid to the cereals pests and the commission in Odessa also examined the phylloxera. During this period the well-known scientists, the professors from Novorossiisk (Odessa) University O.A. Kovalevskyi and I.I. Mechnykov, the entomologists I.M. Vihdalm and P. Zabarynskyi were the members of the commission. In 1894 as a part of the Academic Committee of the Department of Agriculture, the first state institution on plant protection against pests was created in Russia. It was called the Bureau of Entomology and headed by J.A. Porchynskyi (Litvinov et al., 2005, Fedorenko et al., 2013).

At the end of the XIXth century the provincial Zemstvo councils formed the entomological bureaus which were governed by the provincial Zemstvo entomologists and the entomological commissions ceased their activity. In Ukraine the significant work on plant protection was carried out by three such bureaus as Tavriiske (the entomologist S.O. Mokrzhetskyi from 1893), Khersonske (the entomologist J.K. Pachoskyi from 1897), and Kharkivske (the entomologist I.V. Yemelianov from 1905 and V.G. Averin from 1913). They observed the appearance and spreading of the pests, and studied the measures of protection against them. The Tavriiske bureau specialized in the garden pests and Khersonske and Kharkivske ones concentrated their activity in the grain crops pests.

Besides the insects, at the end of the XIXth century the study of harmful mites and nematodes, which significantly damaged agricultural crops, began in Ukraine. V.A. Skorobyshevskyi made the first studies of the mites in the Crimea Nikitskyi Botanical Garden in the 1890s. In 1898 I.K. Tarnani informed about the existence of a root-knot nematode near Uman. Later there were found a sugar beet nematode near Kaniv, a potato stem nematode in Kyiv and Volyn regions, a seed gall nematode near Kerch and a hop cyst nematode in the Kyiv Botanical garden (Litvinov et al., 2005, Fedorenko et al., 2013).

During a long period weevils, webworm beetles, winter moths and

other pests were a big disaster for the Ukrainian beetroot growers. According to the estimated calculations made by S.O. Mokrzhetskyi, the losses incurred only by the beetroot weevils in the late 90s of the nineteenth century, each year averaged 969 thousand rubles in gold, not taking into an account 500 thousand rubles, the cost of sugar beet replanting. In 1899 the beetroot weevils destroyed 5.5 % plantations of sugar beet, the expected harvest of which would cost 2.5-3 million rubles. In 1900-1901 the All-Russian Sugar Manufacturers Society created a Plant Protection Station in the town of Smila in Cherkaska Oblast. Since 1903, Yevhen Mykhailovych Vasyliev, the founder of the system of sugar beet protection from harmful insects, has been working as a head of this station. In 1904, at the expenses of the Southern Russian Society for the Promotion of Agriculture and Rural Industry, the Kyiv Entomology Station was established, and the assistant of the Moscow Agricultural Institute V.P. Pospielov was proposed to head it. The main attention there was paid to the sugar beet pests, the pests of cereals and gardens; and the protective measures against them were also studied there. In 1906 Pospielov published a list of sugar beet pests, which contained more than 140 species. Ye.M. Vasyliev was the chairman of the Organizing Committee of the First All-Russian Congress of Applied Entomology held in Kyiv in 1913. In 1911–1914 the scientific researches on Applied Entomology were carried out at the agricultural research stations. At the Poltava station M.V. Kurdiumov headed the entomology department and he had been working there for 3 years. He substantiated a new trend in the development of Agricultural Entomology, which had been developed by J.K. Pachoskyi, it was the agro technical method of limiting the number of pests. O.V. Znamenskyi became the follower of M.V. Kurdiumov. He continued to study the pests of grain crops and developed the doctrine of his predecessor. At the Odessa experimental station the same department was headed by O.M. Kyrychenko, who later became one of the prominent taxonomists of true bug line. In addition, in 1913 the Entomology Department was organized at the Kharkiv Agricultural Research Station. There it was headed by I.V. Yemelianov. The well-known entomologist M.O. Dobrovolskyi worked at this department. The objects of entomological research were cloropid goud flies, mites, sun pests and the European mole crickets (Litvinov et al., 2005, Fedorenko et al., 2013).

However, at that time neither the scale of scientific research nor the structure of the retarded agriculture allowed using the achievements of

science in full measure, so the losses caused by harmful organisms remained huge; the protection of plants was of a random nature.

After the October events of 1917 at the land departments of the province executive committees and research institution in Ukraine the entomological subdivisions were created. The department of Plant Protection, since 1925 headed by Viktor Hryhorovych Averin and the Republican Plant Protection station, headed by O.O. Mihulin (1932) were formed as parts of the Republican People's Commissariat for Agriculture. The scientific work concerning pest control was concentrated at the agricultural research stations in Kyiv, Poltava, Kharkiv, Myronivka, Skhidno-Stepove and Odessa.

In 1922, for the scientific provision of beet production, the General Management of sugar manufacturing in Kiev established a breeding department of high quality seeds with a network of experimental breeding stations. The Mliivsk Garden and Horticulture Research station, organized in 1921, was the center for scientific research on the garden pests.

In 1925, under the direction of V.G. Averin and O.O. Mihulin, for the first time in Ukraine in Balakliivskyi district of Kharkiv region the testing of aviation means for controlling the Italian locusts and their introduction into the agricultural production were made. The number of the locusts amounted to 250 individuals per 1 m². 1,5 thousand acres, or 70% of the inhabited area were sprayed (Litvinov et al., 2005, Fedorenko et al., 2013).

In 1926, under the direction of O.O. Mihulin, for the first time in Ukraine a signaling and forecasting service for the emergence and spreading of pests was created, the methods of which were later widely practiced in the territory of the former USSR. According to the task of the Council of Labor and Defense, in 1927, under the guidance of O.O. Mihulin a thorough survey of vineyards of Ukraine was conducted, and a map of phylloxera spreading in the republic was prepared. On this basis a system of measures for the protection of vineyards from this pest was developed.

In 1926–1967 J.J. Korab and A.P. Butovskyi conducted a series of studies on morphology, biology, distribution, and harmfulness of sugar beet nematode and they proposed crops protection measures against it. The results of these works are given in the monograph "Beetroot Growing" (1959).

Since the 30s of the XXth century the researches of the scientist from St. Petersburg I.M. Philipiev, the works by K.S. Kirianova and her data on

the survey on the population of the main crops nematodes in the western regions of Ukraine have been of a very importance. Thanks to the works of K.S. Kirianova it became known that there were up to 50 species of nematodes of different groups on the arable land: parasitic, saprobiotic, mycogelidia and free-living ones.

In connection with the creation of collective and state farms in 1929–1930 the new tasks arose. In 1930-1931 about 30 institutes and research stations were organized, in particular, the Institute of Plant Protection in Kharkiv, the scientific director of it became the Phytopathologist T.D. Strakhov, and in 1932 he became the first dean of the first in Ukraine and the former USSR the Department of Plant Protection at Kharkiv Agricultural Institute. The Entomology Department at this institute was headed by M.Ya. Bonardovych. Due to certain objective reasons, in 1934 the Institute of Plant Protection was disbanded (Litvinov et al., 2005, Fedorenko et al., 2013).

At that time the largest entomological laboratories were created at the Ukrainian (later the All-Union) Institute of Sugar Beet (Kyiv), Ukrainian Scientific and Research Institute of Grain Farming (Kharkiv, then Dnipropetrovsk), and at the Ukrainian Scientific and Research Institute of Fruit Production (Kyiv). In other institutes of this branch (Ukrainian Scientific and Research Institute of Viticulture and Winemaking, the All-Union Research Institute of Hemp, Ukrainian Scientific and Research Institute of Cotton) and at the research stations of different departmental subordination were comparatively few departments of plant protection, and in some of them – only the positions of entomologists as a part of the departments of agricultural technology or departments of breeding.

In the early 30s of the XXth century, continuing to explore the fauna of mites in Ukraine, V.M. Voloshchuk described 26 species of mites, the pests of grain and the products of its processing in the repositories of the Crimea.

O.O. Hrossheim devoted many years to the detailed study of insects, the pests of fruit crops during his work at the Mliiv Garden and Horticulture Research station. In 1930 he published his original theoretical work “About Massive Reproduction of Pests”. This work was praised by the well-known entomologists: the professors O.G. Lebediev, F.O. Zaitsev, V.P. Pospielov and M.M. Troitskyi. O.O. Hrossheim regarded the question about the dynamics of insects in space and time as one of the central problems of the

planetary life of the biosphere (according to V.I. Vernadskyi). The original researches on the ecology of insects in the early 30s were carried out at the Department of Terrestrial Animals of the Institute of Zoology of the Academy of Sciences of Ukraine under the direction of Professor O.G. Lebediev. In his paper "About the Importance of Harmful Insects Predictions", published in 1930, he raised the problem of the occurrence of rhythmic fluctuations in the number of insects, their dependence on cosmic factors or on meteorological influences, which operate, however, differently in different places (Beletskij, 2006, Beletskij & Stankevich, 2018).

In 1937 O.G. Lebediev published an article "Electromagnetic field as a forming factor in the life of plants and animals". It contained a hypothesis about the influence of electromagnetic fields on insects, in particular their morphology and ecology. The research workers of the Institute of Zoology S.P. Ivanov, M.M. Levit and E.M. Yemchuk fulfilled the fundamental theoretical generalizations on the problem of the dynamics of insect populations and in 1938 they published the monograph "Mass Reproduction of Animals and the Theory of Gradation", edited by the Academician I.I. Shmalhauzen. It was the first work in Ukraine and in the USSR, in which 325 literary sources of domestic and 686 sources of foreign ecologists on this problem were summed up (Beletskij, 2006, Beletskij & Stankevich, 2018).

In 1939 the Academy of Sciences of the UkrSSR joined the research on Applied Entomology. Three laboratories were created at the Institute of Zoology, and such well-known scientists as V.P. Pospielov, S.V. Zvierezomb-Zubovskyi and M.A. Telenh were invited to head it.

Before the war, the science of plant protection gained the significant development. The pest accounting service was created, the annual reviews of their spreading and forecasts of the expected emergence for the next years were made, which provided a scientific basis for the planning of works (Litvinov et al., 2005, Fedorenko et al., 2013).

In 1944, after the liberation of Ukraine, the restoration of activity of agricultural scientific establishments began. In 1946 an Agricultural Department of the Academy of Sciences of the Ukrainian SSR was organized, which encompassed 5 newly created institutes, including the Institute of Entomology and Phytopathology, later it was reorganized into the Ukrainian Research Institute of Plant Protection (now the Institute of Plant Protection of the National Academy of Agrarian Sciences). It is

Scientific and Methodical Center for Plant Protection in Ukraine.

In the postwar period the country's agriculture faced many problems connected with the pests of sugar beet, cereals, vegetable crops, potatoes, forage grasses, garden plants, and vineyards. Then there appeared new opportunities for improving the protection measures connected with the introducing of the second generation of insecticides – synthetic organic compounds of chlorine and phosphorus. The attention was also paid to the breeding of pest-resistant crop varieties and using biological means. A whole cohort of scientists from many scientific institutions, research stations and higher educational institutions of the agrarian type worked over the problems of plant protection (Litvinov et al., 2005, Fedorenko et al., 2013).

In the 50s and 60s the morphology, biology and plant protection measures from the European brown mite, the European red mite, two-spotted spider mite, and other species of mites were studied under the guidance of I.Z. Livshyts in the Nikitskyi Botanical Garden. During that period the researches at the scientific institutions of Ukraine were concentrated mainly on the questions of ecology of insects, methods of their accounting and development of the theoretical bases and methods of forecasting the population dynamics. The studies of economic thresholds of harmfulness, taxonomy and morphology of insects were widely carried out at that period.

At Kharkiv State University under the direction of Professor O.O. Ustinov a series of studies aimed at the ecologically substantiating measures to protect crops from parasitic nematodes was carried out. The prominent works "The Root-Knot Nematodes" (1959), "Nematode diseases of Agricultural Plants" (1957), "Stem Potato Nematode" (1955) are worth to paid attention to. N.M. Ladyhina continued the work of O.O. Ustinov with dignity (Litvinov et al., 2005, Fedorenko et al., 2013).

An important role in the development of ecological researches of insects belongs to the Professor of Kyiv National University O.F. Kryshtal. He is known to the wide scientific community as a talented organizer and a chairman of the organizing committee of the four the All-Union Ecological Conferences that took place in Kyiv. The first conference was held in 1940, the second one – in 1950. They were mainly dedicated to the discussion of the actual problems of the laws of mass reproduction of animals, including harmful insects, and its prediction. At the third (1954) and the fourth (1962) conferences, in addition to the problem of the population dynamics, the laws of the fauna formation of harmful and useful insects under the influence of

human activity were widely discussed.

In the middle of 60s Professor S.I. Medvediev, the founder of the scientific school on the problems of fauna and ecology of insects, published the results of many years researches at the Department of Entomology of V.N. Karazin Kharkiv National University about the patterns of insect fauna formation in the anthropogenic landscape. Along with it, he convincingly proved that the anthropogenic landscapes were formed mainly from the local fauna. As a result of the violation of the trophic connections the fauna, to some extent, is impoverished.

The impoverishment is mostly expressed under the conditions of monoculture. Agricultural and technical measures partially reduce the danger of mass reproduction; biological factors in modern agricultural technology do not play a significant role in agriculture. The chemical method of pest control, which prevailed at that time, is a present method; it does not contribute to the creation of sustainable, economically useful biocoenosis. O.O. Mihulin, the founder of a scientific school on the problem of the dynamics of pest populations, carefully analyzed the role of the main factors in the dynamics of the number of insects. At the same time, he especially emphasized that the violation in crop rotation and human economic activity in general had an impact on the emergence of massive proliferation of harmful insects. He convincingly proved that chemical method of treatment gave the economic effect only for a certain period of time, and in the future, new measures of crop protection would be needed.

If to keep in mind that the aviation and chemical treatment of forest plantations do not fully cover the area and are not always satisfactory fulfilled, then the population number in the following years is very likely to grow. Such phenomenon has been observed many times in the oak woods of Kharkiv region during the massive spreading of the European oak leafroller.

In the 20-60s of the last century the Ukrainian scientists also made a significant contribution to solving the problems of protecting crops from harmful rodents and snails. In this connection it should be mentioned the scientific works of B.Yu. Falkenshtein, Ye.V. Zverozomb-Zubovskyi, P.O. Svyrydenko, V.G. Averin, O.O. Mihulin, I.T. Sokura, and I.Ya. Poliakova. Their works were devoted to the study of distribution, peculiarities of development, the degree of rodent harmfulness and development of the protective measures. Such scientist as K.P. Hryvanov,

I.M. Lykhariov, A.M. Sokolov and others conducted a great work in the field of studying the snails (Litvinov et al., 2005, Fedorenko et al., 2013).

In the 70s the reference book that described 186 families of harmful and useful species of mites was issued. In the 1980s and 2000s the scientists from the Department of Plant Protection of the Nikitskyi Botanical Garden under the direction of V.I. Mytrofanov, in addition to traditional ecological and faunal and taxonomic researches of parasitic and predatory mites in agroceonoses, also developed the ecological bases for the management of the sustainable development of agricultural landscapes on the basis of the ecosystems theory. They also gave a series of recommendations concerning the methods of research, determinations and the measures for the protection of plants from the mites. I.Z. Livshyts and V.M. Mytrofanov are included into the list of prominent acarologists (*akari* – mites) of the world.

The significant studies in the sphere of Theoretic and Applied Acarology are being conducted at the Institute of Zoology named after I.I. Shmalhauzen at the National Academy of Sciences; there the school of the acarologists has been formed. The important scientific data are included into the works about the biological basis of the harmfulness of acaroids mites and predatory and parasitic Cheyletidae mites. These works were published by the scientists in 1985 and 1990 accordingly. In the monograph "Predatory Mites in the Covered Soil", published by I.A. Akimov and L.A. Kolodochka in 1991, the biological methods of protecting plants from two-spotted spider mites and the western flower thrips with the help of the predatory Phytoseiidae (L.) mites were examined (Litvinov et al., 2005, Fedorenko et al., 2013).

The studies on Agricultural Acarology are also conducted by the scientists of the Institute of Plant Protection, the Institute of Horticulture, and other institutions of National Academy of Agrarian Sciences, and also of agricultural higher educational establishments.

The scientists M.Ya. Dayilevskyi, M.A. Dobrovolskyi, O.O. Sylantiev, I.K. Rakhmaninov, I.K. Tarnani, Ye.V. Zviezoromb-Zubovskyi, M.O. Kamyshnyi, I.D. Bilanovskyi, Ye.M. Savchenko, V.V. Shcherbakov, V.P. Vasyliev, M.A. Telenha, M.F. Rudniev, O.J. Petrukha, M.P. Diadechko, I.I. Korab, Ye.M. Zhytkevych, Ye.V. Klokov, B.M. Lytvynov, O.V. Zahovora, B.A. Areshnikov, J.T. Pokozii, V.G. Dolin, P.I. Sussidko, V.M. Pyssarenko, S.O. Trybel, V.P. Fedorenko, V.S. Shelestova, Ye.M. Biletskyi and others made a

significant contribution to the theoretical and practical development of Agricultural Ecology during the historical period of its development in Ukraine.

The scientists of Zoology and Entomology Department of Kharkiv National Agrarian University named after V.V. Dokuchaiev have been carrying the researches in the field of agricultural entomology. Four academic schools, founded by the professors V.G. Averin ("Comparative and Ecological Approach in Population Dynamics Research"), O.O. Mihulin ("The Problems of the Dynamic of Harmful Organisms Population"), B.M. Lytvynov ("Ecologically Oriented System of Fruit Plantings Protection from Pests"), and Ye.M. Biletskyi ("The Problem of the Long Term Forecasting of Mass Reproduction of Harmful Insects") were formed here (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

The present stage of the agro-industrial complex development is characterized by the growing influence of economic activity on the agricultural biocoenosis and on the biosphere in general. Along with it, the problems of insect population ecology, the forecasting of their mass reproduction outbreaks, foundation of ecologically oriented, environmental and resource-saving technologies of plant protection are paid the special attention to. The vast majority of these issues are successfully solved by the Ukrainian research establishments and educational institutions (Litvinov et al., 2005, Fedorenko et al., 2013).

The Department of Zoology and Entomology named after B.M. Lytvynov is the flagship of domestic agricultural entomology. The Department of Zoology and Entomology was founded in 1840 after joining the Marimont Institute of Agricultural Management of the Warsaw Forestry School. At that distant time, the foundations of educational, methodological and scientific works were laid by the well-known Professors V.M. Yastrzhembskyi and L.F. Bogutskyi; the Master of Zoology, Professor A.D. Karpynskyi, who headed the Department from 1840 to 1871; the Ph. D. in Natural Sciences Ye.M. Vasyliev (a well-known scientist, an expert on sugar beet pests), who headed the department from 1876 to 1890 (Litvinov et al., 2005, Golikova et al., 2011, Fedorenko et al., 2013).

The period from 1890-1905 was marked by a sharp decrease in the number of students after their riots in 1891-1892. It was connected with the difficult internal situation in Russia, the prolonged severe drought, poor

harvest and the terrible famine of 1891-1892 (35 million people were starving in Russia at that time). But, despite the difficulties, the government, following the results of the commission, agreed to maintain the higher agricultural education in Russia (Beletskij, 1996, Biletskij, 2006).

From 1905 to 1930, the Department was headed by the Professor Ivan Kostiantynovych Tarnani, a talented teacher, naturalist and popularizer, student's favorite. In 1914, after moving to Kharkiv together with the institute, he improved the teaching of Zoology and Entomology, and conducted the researches on harmful organisms in Kharkiv province.

From 1930 to 1956, the Department was headed by the Professor, Doctor of Agricultural Sciences V.G. Averin, and a well-known encyclopedic scientist, who headed the Plant Protection Department of the People's Commissariat of Agriculture of Ukraine. He devoted 26 years to scientific researches on the problems of plant protection, and for the first time, in the 1930s of the last century, he substantiated the necessity of a comparative and ecological approach while studying the population dynamics in Zoology and Entomology. He has trained three Philosophy Doctors (Kirichok, 2001, Golikova et al., 2011, Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

From 1956 to 1971, the Department was headed by the Doctor of Biological Sciences, Professor O.O. Mihulin, an outstanding scientist in the field of Theoretical and Applied Zoology and Agricultural Entomology. For several years O.O. Mihulin has been in charge of the Central (Republican) Plant Protection Station. Under his leadership, in 1925, a signaling and pest spreading forecasting service was organized in Ukraine, the methods of which were later extended in the territory of the former USSR, and in 1926 Izium and Kupiansk observation posts were organized. In accordance with the task of the “Soviet of Labor and Defense” organization under the guidance of O.O. Mihulin (1927) a comprehensive survey of the Ukrainian vineyards was conducted; the map of phylloxera spreading in the republic was made. On the basis of this work, the law about the measures to combat this pest has been issued. Professor O.O. Mihulin founded a historic and statistical approach to the protection of plants when analyzing the population dynamics of harmful organisms. He trained two Doctors of Sciences and 23 Philosophy Doctors (Kirichok, 2001, Golikova et al., 2011, Puzik et al., 2016, Zabrodina et al., 2017).

Under the direction of V.G. Averin and O.O. Mihulin (1924) for the first

time in Ukraine in the area of Savyntsi village in Balakliiskyi district of Kharkiv region an aero-chemical way of protecting crops from the Italian locust was tested, and it was introduced into production. In 1931–1932 V.G. Averin and O.O. Mihulin took an active part in the creation of the first Plant Protection Faculty in Ukraine at Kharkiv Agricultural Institute named after V.V. Dokuchaiev (Puzik et al., 2016, Zabrodina et al., 2017).

From 1971 to 1991 the Department was headed by the Doctor of Biological Sciences, Professor B.M. Lytvynov, a well-known scientist and teacher, a follower of the scientific and pedagogical school of Professors V.G. Averin and O.O. Mihulin. The Department was well known far beyond Ukraine (Kirichok, 2001, Golikova et al., 2011, Evtushenko & Baydik, 2011, Evtushenko & Baydik, 2015, Puzik et al., 2016).

Lytvynov B.M. is the founder of the fundamental trend, namely the population dynamics of fruit crop pests and he also developed a complex environmentally-oriented system of crops protection. His thesis research goes beyond the traditional chemical methods of plant protection and has all the signs of the integrated protection, although this term is not used in his work of many years. The protection of fruit plantings proposed by him combines the study of a complex of organisms interrelated for a long time (15 years) and a special tactics of destructive measures by regulating the number of the pests and bringing it to a certain size, as well as the use, in addition to chemical, biological and microbiological methods of protection (Kirichok, 2001, Golikova et al., 2011, Evtushenko & Baydik, 2011, Evtushenko & Baydik, 2015, Puzik et al., 2016).

Lytvynov B.M. has trained two Doctors of Sciences and 24 Philosophy Doctors. The students and followers of B.M. Lytvynov continue the researches of his scientific school concerning the urgent issues of improving the environmentally-oriented protection of fruit and other crops from pests.

Lytvynov B.M. is a co-author of two editions of the textbook “Agricultural Entomology” (1976, 1983) edited by A.O. Mihulin, the “Guide to the Protection of Plants” (1989), the manual “Agricultural Entomology” (1997), the last two works were published by his edition. To ensure the educational process during the years of Ukraine's independence, the editorial board published the textbooks “Agricultural Entomology” (2005), “Agricultural Entomology Workshop” (2009), two editions of the textbook “Pests of Forest Plantations” (2005, 2008), and “Agricultural

Entomology. The Names of the Main Pests of Agricultural Crops and Forest Plantations" (2007, 2010) edited by him (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

B.M. Lytvynov paid a great attention to the improvement of the educational process, and the aesthetic appearance of the Department. Under the direction of the scientist and thanks to his active participation, a series of unique visual training manuals for the preparation, control and self-control of students' knowledge on special disciplines: Zoology, General and Agricultural Entomology (the co-author is the Associate Professor V.I. Oparenko) was created. For 11 years B.M. Lytvynov successfully headed the Kharkiv Branch of the Ukrainian Entomological Society, for 5 years he headed a Specialized Academic Council for the defense of Doctors of Sciences and Ph. D. in the specialty "Entomology", for 15 years he placed himself at the head of the economic and contractual thematic work on the introduction of new scientific developments of the Department in production, for many years Lytvynov was the editor-in-chief of the collected articles of the scientific works of the Faculty of Plant Protection's staff (Biletskij, 2015, Evtushenko & Baydik, 2015).

According to the decision of the Academic Council of Kharkiv National Agrarian University named after V.V. Dokuchaiev (proceedings № 2, February 25, 2015) the Department of Zoology and Entomology was given the name of Professor B.M. Lytvynov (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

Professors V.G. Averin, O.O. Mihulin, B.M. Lytvynov laid the foundation of the priority direction in Ecology and Plant Protection, the direction of managing the dynamics of harmful and beneficial organisms population, they trained the talented students and their followers. At that time, the staff of the Department worked fruitfully under the leadership of these scientists. The considerable attention was paid to training the Doctors of Sciences and Philosophy Doctors. In the 1960s and 1980s, the teachers of the Department developed and implemented the course "Harmful Nematodes, Mites, and Rodents" into the educational process, they specified the economic thresholds of harmfulness of many species, developed and produced the first in the institute the automated training stands on the taxonomy of insects and pests of agricultural crops.

Professors Ye.M. Biletskyi, B.M. Lytvynov and Associate Professor M.O. Bilyk carried out the large-scale studies on the biology and ecology of

egg parasites in order to seasonally colonize them against the sun pest and codling moth. However, under modern conditions this method has not proved itself.

The group of scientists from the Institute of Plant Cultivation named after V.Ya. Yuriev (Y.M. Biletskyi, V.M. Grama, V.P. Grytsayi) and from Kharkiv National Agrarian University named after V.V. Dokuchaiev (B.M. Lytvynov, V.I. Oparenko, M.O. Filatov) made the monographic studies of the fauna and ecology of the wild bees, the pollinators of alfalfa. The effective methods for preservation, accumulation and protection of the pollinators have been determined, and the integrated protection of seed alfalfa from harmful organisms has been developed (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

Maintaining the famous traditions of the founders of the Faculty of Plant Protection, Professors V.G. Averin and O.O. Mihulin, the scientists of the Department of Zoology and Entomology of Kharkiv National Agrarian University named after V.V. Dokuchaiev continue the researches in the direction of "Development of the Theory and Methods for Managing the Populations Dynamics of Harmful and Useful Insects on the Basis of Phytosanitary forecasts". The scientists of the Department have substantiated the systematic theory of the population dynamics cycling and its technological solution as for developing a long-term (strategic) forecast of mass reproduction of harmful insects (Ye.M. Biletskyi). On the basis of this theory, an inter-system method of prediction of the massive propagation of the webworm beetle, winter moth, chloropid goud flies, sun pest, corn ground beetle and the locusts for Africa and the Middle East, the cotton bollworm for the People's Republic of China (Ye.M. Biletskyi), the apple ermine, fruit moth and blossom weevil (B.M. Lytvynov, M.D. Yevtushenko), the cabbage moth and butterfly (L.Ya. Sirous) has been developed (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

Under the direction of Professor O.V. Zakharenko the fundamental faunal studies of net-winged insects in Ukraine and other regions and the studies of their ecology and economic significance were carried out. At the same time Professor O.V. Zakharenko paid the special attention to the researches in the field of nature conservation in Ukraine and to developing the environmental protection measures.

J.T. Pokozii, D.A. Khovrina, Z.P. Boryssova, L.F. Krasnopolska,

Kh.Kh. Ramakaiev (the Dean of Plant Protection Faculty in 1970-1992), V.I. Tsybulko, K.G. Vahanova, A.J. Kovalyk, V.I. Oparenko, O.V. Zakharenko, G.I. Sharuda, O.I. Miezentsev, O.L. Zozulia, A.P. Lukianchenko, and O.S.Tertyshnyi were the members of the Department in different time.

From 1991 to 2010, the Department of Zoology and Entomology was headed by the Doctor of Biological Sciences, Professor, Academician of the Academy of Pedagogic Sciences of Ukraine Ye.M. Biletskyi. He substantiated the system theory of the population dynamics cycling and developed an inter-system method for forecasting mass reproduction of harmful insects. This method is used in Ukraine, the countries of CIS, the Congo, Nigeria, and the countries of the Middle East, the state of Florida (USA) and in China. Ye.M. Biletskyi has trained two Doctors of Sciences and 13 Philosophy Doctors. He founded a scientific school "The Problems of the Long-Term Prediction of Mass Reproduction of Harmful Insects". Ye.M. Biletskyi is a co-author of the branch standards of Educational Qualification Directions "Bachelor" and "Master" in the direction of "Plant Protection" at the Ministry of Education and Sciences; he is also a co-author of the educational textbook and manual "Agricultural Entomology" and five monographs. He published the monograph entitled "Mass Reproduction of Insects. Their History, Theory, and Forecasting" (2011). At the Department of Zoology and Entomology, in the whole, four scientific schools were created by the Professors V.G. Averin, O.O. Mihulin, B.M. Lytvynov, and Ye.M. Biletskyi.

From 2010 to 2016, the Ph. D. in Agricultural Sciences, Associate Professor G.V. Baidyk headed the Department of Zoology and Entomology named after B.M. Lytvynov. She is one of the many followers of Professor B.M. Lytvynov. Her scientific interests are the study of the laws of the long-term dynamics of pest populations of cereal crops and the improvement of the integrated system of plant protection. She is a co-author of one textbook and seven manuals, etc. (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

From 2018 the Department has been headed by B.M. Lytvynov's follower, Ph. D. in Biological Sciences, Professors, the Honored Rector of Kharkiv National Agrarian University M.D. Yevtushenko.

At present the Department is run by the Professors M.D. Yevtushenko (the Honored Rector of Kharkiv National Agrarian University, he was at the

head of the University in 1996–2007), V.L. Mieshkova, Ye.M. Biletskyi, the Associate Professors G.V. Baidyk, L.Ya. Sirous, I.P. Lezhenina, M.O. Filatov, D.D. Yushchuk (the Administrative Vice-Rector), I.V. Zabrodina (the Dean of Plant Protection Department), S.V. Stankevych (the Deputy Dean of Plant Protection Department), the teacher Yu.V. Vasylieva, Ph. D. in Agricultural Sciences V.V. Vilna and senior laboratory assistants N.P. Varzhelenko, and A.O. Salina. The Department trains specialists of the Education Level "Bachelor" and "Master" in the field of "Protection and Quarantine of Plants". The teachers of the Department provide the educational process at the following faculties: Plant Protection, Agronomy, and Soil Science, and Forestry (the full-time and extra mural forms of training).

During the years of Ukraine's independence, the teachers of the Department issued the textbook "Agricultural Entomology" (2005), the manuals "Agricultural Entomology Workshop" (2009), and "The Pests of Forest Plantations" (2005, 2008) with the stamp of the Ministry of Agrarian Policy of Ukraine. They also published the textbooks for the Ukrainian agrarian universities and, in fact, fully ensured the educational process at the Department.

The main trend of the research work at the Department is to substantiate the theory and develop the techniques for managing the dynamics of harmful and useful insects' populations on the basis of phytosanitary forecasts of different ages, which includes 14 sections.

In 1980 the laboratory on the problems of insect ecology was formed at the Department. It was headed by Ph.D. in Biological Sciences V.M. Grama. The staff and the teachers of the Department developed the ecological bases of the integrated protection of agricultural crops taking into account the environmental protection. The laboratory ceased its work in 2010 (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

Professor O.V. Zakharenko (1948–2004) studied the fundamental problems of taxonomy and ecology of insects. He was the leading entomologist-neuropterologist of the world level, the ecologist, who investigated the problems of the steppe, and was the specialist in nature saving. He has developed new approaches to the organization and optimization of nature conservation. Professor O.V. Zakharenko founded the journal "The News of the Kharkiv Entomological Society" and for many years was its editor-in-chief. He has trained one Doctor of Sciences and

three Philosophy Doctors.

V.L. Mieshkova, the Doctor of Agricultural Sciences, Professor has trained seven Philosophy Doctors. She is an author of four monographs, one patent, a co-author of a textbook with the stamp of the Ministry of Agrarian Policy, etc. Her scientific interests are the study of the dynamics of forest insects' population, their spreading and harmfulness.

At present the follower of B.M. Lytvynov's scientific school, Professor M.D. Yevtushenko together with his students I.V. Zabrodina, S.V. Stankevych and V.V. Vilna fruitfully conducts the researches in the priority areas, namely, the many-years population dynamics and the forecast of mass reproduction of pests of fruit crops, rape and mustard. According to the results of the researches in relation to pests of rape and mustard, M.D. Yevtushenko and S.V. Stankevych got two patents for useful models and a gold medal at the "Agro-2014" exhibition in Kyiv. M.D. Yevtushenko is the Honored Worker of Education of Ukraine, the author and co-author of three textbooks, two workshops, 20 manuals, four monographs, three inventions, etc. He has trained three Philosophy Doctors for the Department.

The fundamental investigations of the structure and functioning of the two-winged complex in agricultural coenoses are studied by Associate Professor I.P. Lezhenina (she has trained one Ph. D.); she is a co-author of the textbook "The Red Book of the Kharkiv Region" The investigation of I.P. Lezhenina and Yu.V. Vasylieva are dedicated to a complex of pests, pollinators and entomophags of seed amaranth. They received a patent for a useful model. They are the co-authors of two manuals on Rodentology (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

The methods of using wild bees' pollinators of alfalfa and other melitophyll crops and the bases of their protection are developed by Associate Professor M.O. Filatov. For this development he received a gold medal at the "Agro-2013" exhibition in Kyiv. He is a co-author of the editions "The Red Book of Ukraine", "The Red Book of the Kharkiv Region", "The Red Book of Dnipropetrovsk Region" and "The Red Book of the Crimea".

The Postgraduate Courses and Doctoral Studies in the specialty "Entomology" are functioning at the Department. Over the past half century 85 Philosophy Doctors and eight Doctors of Sciences have been trained.

Ye.M. Biletskyi, M.D. Yevtushenko, V.L. Mieshkova, G.V. Baidyk, and L.Ya. Sirous, the teachers of the Department, during several cadences

took an active part in the certification of the personnel of the highest qualification at the Specialized Scientific Council in the specialty "Entomology and Phytopathology".

On the occasion of the 175th anniversary of the Department on May 21–22 2015, an International Scientific and Practical Conference "Fundamental and Applied Researches in Zoology" has been held (Puzik et al., 2016, Zabrodina et al., 2017, Ulyanchenko et al., 2018).

The conclusions.

The need to find the measures to control pests and the aspiration of man to knowledge became the source of the origin of Scientific Entomology. The history of plant protection science is closely linked to the diverse role of insects and other animals in nature and human life and it needs to be studied in detail. Ukrainian researchers are also rightfully assigned to the cohort of prominent plant protection scientists in the world.

In 1878 the first Zemstvo Ecological Commission was created in Kharkiv, and in 1882 the second such commission was formed in Odessa. Their task was to observe the crop pests and develop the measures to protect the plantations from them. At the end of XIXth century the provincial Zemstvo councils formed the entomological bureaus, which were governed by the provincial Zemstvo entomologists, and the entomological commissions ceased their activities. Three such bureaus, namely Tavriiske (entomologist S.O. Mokrzhetskyi since1893), Khersonske (entomologist J.K. Pachoskyi since 1897) and Kharkivske (entomologist I.V. Yemelianov since 1905 and V.G. Averin since 1913) carried out a significant work in Ukraine.

After the October events in 1917, the Subdivisions on Entomology were created at the land departments of the province executive committees and research institutions of Ukraine. The department of plant protection, since 1925 headed by Viktor Gryhorovych Averin, and the Republican Plant Protection Station at the head of O.O. Mihulin (1932) at the People's Committee of Land were formed. In 1930–1931, about 30 institutes and research stations were organized; in particular, the Institute of Plant Protection in Kharkiv, the phytopathologist T.D. Strakhov was appointed on the position of its director. In 1932 T.D. Strakhov became the first Dean of the first in Ukraine and former USSR Plant Protection Department at Kharkiv Agricultural Institute.

In 1946 an agricultural department at the Academy of Sciences of the Ukrainian SSR was organized, which encompassed 5 newly created institutes, including the Institute of Entomology and Phytopathology, later reorganized into the Ukrainian Research Institute of Plant Protection. Now it is the Institute of Plant Protection of the National Academy of Agrarian Sciences and the Scientific and Methodical Center for Plant Protection in Ukraine.

The Department of Zoology and Entomology named after B.M. Lytvynov of Kharkiv National Agrarian University was founded yet in 1840 after joining the Marimont Institute of Agricultural Management of the Warsaw Forestry School.

From 1905 to 1930, the Department was headed by the Professor Ivan Kostiantynovych Tarnani; from 1930 to 1956, the Department was headed by the Professor, Doctor of Agricultural Sciences V.G. Averin; from 1956 to 1971 it was headed by Doctor of Biological Sciences, Professor O.O. Mihulin. From 1971 to 1991 Doctor of Biological Sciences, Professor B.M. Lytvynov was at the head of the Department; from 1991 to 2010 it was Doctor of Biological Sciences, Professor, and Academician of the Academy of Pedagogic Sciences of Ukraine Ye.M. Biletskyi; from 2010 to 2016 it was headed by Ph. D. in Agricultural Sciences, Associate Professor G.V. Baidyk. Since 2018 Ph. D. in Biological Sciences, Professor, the Honored Rector of Kharkiv National Agrarian University named after V.V. Dokuchaiev M.D. Yevtushenko has been at the head of the Department.

Four academic schools, founded by the professors V.G. Averin ("Comparative and Ecological Approach in Population Dynamics Research"), O.O. Mihulin ("The Problems of the Dynamic of Harmful Organisms Population"), B.M. Lytvynov ("Ecologically Oriented System of Fruit Plantings Protection from Pests"), and Ye.M. Biletskyi ("The Problem of the Long Term Forecasting of Mass Reproduction of Harmful Insects") were formed at the Department.

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STRENGTHENING VECTORS AND CHALLENGES FOR PROFESSIONAL ECONOMIC AND FINANCIAL EDUCATION INVOLVING AI

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Professional economic and financial education has unique opportunities to use artificial intelligence for digital development during the period of transformation, in particular, in the training of specialists, as well as in increasing the economic and financial literacy of the population in general. The realization of this potential requires a well-developed strategy that is consistent with national interests and takes into account ethical and infrastructural aspects. A balanced, human-centered approach to innovation will allow shaping an educational trajectory leading to a knowledge economy, a financially literate society, and a competitive country.

***Key words**: education, economics, finance, digital technologies, artificial intelligence, development strategies, educational models, educational guidelines.*

Introduction.

In today's world, financial literacy and quality financial education have become strategically important for the economic development of countries. International studies show that the level of financial literacy of the population remains low in many countries (even economically developed ones), which negatively affects the economy and deepens inequality [1]. At the same time, a higher level of financial literacy is consistently associated with positive financial behavior of citizens - increased savings, more responsible use of credit, and informed investment decisions - which increases the economic resilience of both individual households and society as a whole [2]. Today, financial education of citizens is seen as one of the key factors of national economic security and development: improving financial literacy can strengthen economic stability, reduce inequality, and create the basis for inclusive growth [2]. Properly trained financial professionals and financially literate citizens contribute to more efficient functioning of markets, entrepreneurship, and

sound economic decision-making at all levels.

Education is especially relevant for countries experiencing rapid socio-economic changes and integrating into the global economy. For Ukraine, the issue of financial literacy has become a matter of national importance, and the National Strategy for Improving Financial Literacy until 2030 has been adopted, reflecting the government's awareness of the critical role of financial education in ensuring sustainable development [3]. A number of studies conducted by the NBU and international organizations have recorded a gradual increase in the overall financial literacy index of Ukrainians, but it is still only about 58% of the maximum level (12.3 points out of 21 in 2021) [4]. This indicates significant room for improvement, especially given the new challenges of the digital economy and financial technologies.

An additional factor in the relevance of the topic is the introduction of artificial intelligence (AI) in various fields, including the educational process. AI is already being compared to high-level impact, i.e., to a technology that simultaneously carries enormous transformation opportunities and significant risks [5]. In the field of education, artificial intelligence promises to help solve key problems - personalize learning, increase teaching efficiency, expand access to knowledge - and accelerate progress towards the UN Sustainable Development Goals (in particular, SDG4 - quality education) [5]. In financial education, these opportunities are especially valuable. AI can provide students with individualized tips, model complex economic scenarios, facilitate learning through interactive simulations, etc. According to researchers, generative AI (e.g., large language models like ChatGPT) already plays an important role in improving financial literacy of different segments of the population, although it also puts new demands on the financial education system [6]. Thus, the combination of economic and financial education and modern artificial intelligence technologies is becoming a critical area that determines the competitiveness of education in the digital transformation.

Analysis of recent research and publications.

The issues of economic and financial education and the introduction of AI in the educational process are actively studied by both Ukrainian and international scholars. Let's analyze a number of relevant scientific publications of recent years that cover various aspects of this interdisciplinary topic.

Osetskyi V. et al. [7] investigated the trends in the use of artificial intelligence in education and the related financial and economic benefits and

challenges. The paper provides an overview of new horizons of learning thanks to AI, as well as potential threats (reducing the need for teachers, problems of student socialization, etc.) The authors note that despite these implementation risks, the market for AI technologies in education is growing rapidly on a global scale (North America and East Asia are leading the way). Having compared the success of countries in the economic sphere with the level of AI penetration in education, the researchers concluded that the use of AI in educational systems increases the accessibility of knowledge and the quality of education, which positively affects the competitiveness of both individual specialists and the economy as a whole. Accordingly, investments in innovative AI training programs are considered an important vector of economic growth and are recommended to be supported by the state educational policy.

Geenko M. M., Rybina L. O., Guzenko T. S. [4] focused on the role of higher education institutions in the formation of financial literacy of future specialists and professional development of personnel. In their research, the authors distinguish two categories of financial literacy - professional and personal - and emphasize that the first is formed in the process of studying at a higher education institution, and the second determines a person's ability to manage personal finances. The researchers analyzed the dynamics of the financial literacy index in Ukraine and confirmed the existence of a direct link between the level of education and financial awareness of the population. An important conclusion of the study is that only a comprehensive and systematic approach in the activities of universities will allow developing the economic, financial and intellectual potential of students, contributing to their success and the development of the country as a whole in the long term. Thus, the authors emphasize the responsibility of educational institutions in training financially literate professionals as part of the state's human capital development strategy. Lusardi A., Mitchell O. [8] conducted a thorough study of the global state of financial literacy and its impact on the financial behavior of the population. The study showed that insufficient financial awareness is a widespread problem not only in developing countries but also in developed economies. Particularly low financial knowledge is observed among vulnerable groups, such as young people, people with low levels of education, and women. These are negative outcomes, as financial illiteracy leads to irrational borrowing, lack of savings, and other behavioral patterns that undermine family welfare and economic stability. This study emphasizes the need for large-scale financial education programs at the state

level and provides a theoretical basis for many subsequent studies. Katnić I., Katnić M., Orlandić M. [9] studied the role of financial literacy in ensuring economic sustainability and stability on the example of Montenegro. They empirically confirmed that more financially literate households demonstrate better money management practices (higher savings rates, prudent use of debt), which increases their resilience to economic shocks. Improving financial education, according to the authors, contributes to long-term financial stability, reducing inequality and inclusive growth, and thus is a tool for sustainable development. They emphasize the need for government support for policies that promote financial education to mitigate the impact of external shocks on the economy. This study emphasizes the importance of financial education for national economic security not only in large countries, but also in small open economies exposed to global market fluctuations.

Mahaney J. [1] considers the potential of artificial intelligence (in particular, specialized language models based on GPT) in overcoming negative factors. The author notes that AI is able to provide the general public with access to accessible and accurate financial information, in fact, a “personal financial advisor” for each person in a digital format. Individualized advice and educational modules generated by AI can help people make more informed financial decisions, thus reducing the negative consequences of illiteracy (excessive debt, lack of savings, etc.). The author concludes that the introduction of AI in financial education can narrow economic inequality by providing people with different income levels with equal opportunities to acquire the necessary knowledge. At the same time, it is emphasized that it is important to ensure the accuracy and reliability of such AI advisors in order to avoid the dissemination of false information.

Córdova P. et al. [10] investigated the practical aspects of integrating artificial intelligence tools into finance education in higher education institutions. The focus of their study is on students' perception of such tools, emotional reactions to them, and the experience of teachers. The results showed that the use of AI tools can significantly transform financial education, providing a more engaging learning experience and better preparing students for their future careers. In particular, students noted an increase in motivation and interest in the subject when chatbots, intelligent learning systems, or simulators were used to practice financial cases. At the same time, the authors emphasize that the maximum benefit from such innovations is achieved with a balanced approach - ethical and psychological aspects must be taken into account to minimize potential

negative consequences (e.g., dependence on AI prompts or student anxiety). This study is valuable because it offers practical recommendations for teachers of financial disciplines on how to implement AI: from the need to train teachers themselves in new technologies to adapting curricula to take into account the capabilities of artificial intelligence. Nguyen A. et al. [11] also devoted their work to ethical issues in the application of artificial intelligence in education. Although their study is not narrowly focused on financial education, its conclusions are directly relevant to the introduction of AI in any educational field. They note that the use of AI in Education has been growing rapidly in recent years, but ethical risks and concerns have also been growing at the same time, primarily regarding student data privacy, student autonomy in learning, and algorithm transparency. The authors analyzed the policies and principles of various international organizations (UNESCO, the EU, etc.) and, based on a thematic analysis, formulated a set of universal ethical principles for artificial intelligence in education. They include the following: data protection and privacy, ensuring fairness and non-discrimination in algorithms, accountability of AI systems, preserving the role of humans (teachers) in decision-making, transparency and explanability of AI, well-being and psychological comfort of students, etc. This publication is important because it outlines the ethical framework that should be followed when implementing intelligent technologies in education, including financial education.

Roberts M. [6] draws conclusions on the possibility of generative AI to solve the problem of economic and financial illiteracy based on the analytical research conducted. He points to a “dual effect”: on the one hand, ChatGPT and similar models open up new opportunities for self-education in finance (users can get instant advice on personal financial issues, explanations of complex concepts, etc.) On the other hand, the widespread adoption of such technologies puts additional pressure on the financial education system - there is a need to teach people to think critically and check AI answers, and to adapt curricula to take into account new tools. The author emphasizes in his study that the role of the teacher and formal education remains key: AI does not replace the need for basic financial knowledge, but rather reinforces it. Educators should teach students how to maximize the use of AI tools and at the same time understand their limitations. This paper demonstrates a practicing financier's perspective on the disruption of technology in education and emphasizes the need to modernize educational trajectories in the AI era.

These publications reflect a wide range of important issues related to

strengthening economic and financial education and the cautious integration of artificial intelligence into the educational process. They complement each other: empirical evidence confirms the economic effect of financial literacy, technological research shows possible ways to improve learning with AI, and ethical and pedagogical works warn against uncontrolled technology implementation. Together, they form the scientific basis for developing strategies for the development of professional economic and financial education in the current environment.

The Results.

Economic and financial education is directly related to national interests, as it affects the long-term economic stability and well-being of the country. Financially literate citizens are able to make informed decisions about saving, investing, lending, and risk management, which means a more resilient financial system and less vulnerability to crises on a national scale. Studies show that countries with a higher average level of financial literacy have higher economic resilience: households there save more, fall into fewer debt traps, and are better able to adapt to external shocks [9]. For example, the aforementioned study from Montenegro emphasizes that financial education acts as a "stabilizer" for the economy, softening the impact of external shocks (such as crises or pandemics) on the population [9]. For Ukraine, strengthening the financial literacy of the population is also a matter of national economic security, especially in the context of integration into global financial markets and after the shocks of recent years.

In addition, professional economic and financial education is a direct investment in human capital, which determines the competitiveness of companies, including in the national economy. In the field of finance, highly qualified personnel (economists, financial analysts, bankers, auditors, fintech specialists, etc.) are the basic specialists for the development of the economic sphere and financial sector, capital markets, and the investment attractiveness of the economy. The formation of such specialists requires high-quality education that meets modern challenges and standards. Ukraine's national interests dictate the need to build human and intellectual capacity in the financial sector, as stated in the research of domestic scholars [4]. They emphasize that the financial literacy of students of economic and management specialties should be considered a strategic priority of higher education, since it is higher education institutions that lay the professional financial competence of future managers and entrepreneurs [4]. Thus, by ensuring a high level of graduate training in finance, the state simultaneously strengthens its economic sovereignty and growth prospects.

Another dimension of national interests is ensuring social stability and reducing inequality. Financial education plays an important role here, as it provides citizens with the tools to improve their own well-being. Individuals who understand the principles of saving, investing, and retirement planning are less dependent on government assistance in the future and are better able to protect themselves from poverty in old age. As noted in [1], the availability of financial knowledge through the latest educational solutions (including AI) can reduce economic disparities, expanding financial opportunities for previously underserved groups. For Ukraine, with its traditionally high income disparities, spreading financial literacy among all segments of society (youth, rural population, pensioners, veterans, etc.) is in the national interest of social cohesion. Recent initiatives, such as financial literacy courses for military personnel, programs for the elderly, and the integration of financial literacy into school curricula, all contribute to a more mature and responsible society.

In a broader sense, financial education influences the formation of a nation's financial culture. The level of trust in financial institutions, participation of the population in the stock market, and the popularity of entrepreneurship - these indicators depend on the extent to which citizens understand financial processes and feel confident in economic life. Accordingly, improving financial literacy is on the agenda of many countries. For example, the Strategy for the Development of the Financial Sector of Ukraine until 2025 contains a section on financial inclusion and public awareness [4], and the National Bank, with the support of international partners, implements educational campaigns (financial literacy weeks, competitions for young people, etc.). In the global context, Ukraine, seeking to join the EU, should also take into account the OECD recommendations on financial education, as financial literacy is recognized as one of the indicators of sustainable development [12-14]. Investments in economic and financial education today can be compared to investments in the country's future economic growth and financial independence, for example, during the post-war recovery.

One of the biggest advantages that artificial intelligence offers in education is the ability to personalize learning. Traditional systems often move at a common pace for all students, while everyone’s level of preparation and learning needs are different. Adaptive AI-based learning platforms are able to adjust the material and tasks to the individual progress of the student. Algorithms analyze performance, knowledge gaps, learning style and based on this offer individual educational trajectories. According

to survey studies, AI technologies allow students to learn at their own pace and focus on those topics that require more attention [15]. For example, if a student in economics or finance is having difficulty with the topic of discounting cash flows, an adaptive system will record this and offer additional explanations or practical exercises on that topic before moving on. On the contrary, if a topic is well-learned, AI can speed up the passage or offer in-depth material for development. As a result, a personalized learning trajectory is formed: strong students do not get bored, and weak ones do not "drop out" of the process, everyone receives the optimal level of challenge. Research confirms that this approach increases engagement and success: students demonstrate better results and higher motivation when learning is personalized using AI [15]. Adaptive platforms and intelligent tutors. In practice, personalization is implemented through various tools. First, these are adaptive learning environments and platforms (LMS) with elements of artificial intelligence that dynamically change content. There are already commercial and open solutions used in economic and financial education: from testing systems with adaptive complexity of questions to interactive textbooks that adjust examples to the interests of the student (for example, for IT business, financial cases from the field of technology will be presented). Second, chatbots and virtual tutors. In finance education, these can be assistants who are available 24/7 to answer questions. For example, a student preparing for a corporate finance exam and wants to clarify the difference between IRR and NPV can ask a chatbot, which, having access to the course knowledge base, will provide clarification. Research by scientists also notes that such intelligent auxiliary tools increase student engagement and provide an increased effect of feedback, which is especially valuable for self-study [15]. It is important that modern AI models (in particular generative ones) are able not only to give standard answers, but also to explain complex concepts in simple words, provide analogies, correct errors in solving problems - that is, to actually simulate the functions of a mentor, which opens up new opportunities for scalable individualization, i.e. each student can receive a conditional "personal tutor" in the person of an AI system.

In education, practical experience in learning to apply theory in real-world situations is extremely important, so it is important to include computer simulations enhanced by artificial intelligence. Traditionally, business schools use educational games and market simulators (for example, students are offered to play on a virtual stock exchange or take a "quest" on personal financial planning). Modern AI simulators are able to make these

scenarios much more realistic and dynamic. With the help of AI, complex situations can be simulated that unfold differently depending on the student's actions. For example, the system can simulate the volatility of the financial market: the student, acting as a trader, makes decisions about buying and selling assets, and the AI changes the market parameters (stock prices, interest rates, news background) in response to his actions or random events [16]. Such learning through experience allows you to hone your decision-making skills under the pressure of risk without real financial losses. Another example is the simulation of the activities of a financial manager: the system can simulate the work of an enterprise, where the student must allocate a budget, cope with cash gaps, and choose the optimal method of financing a project. The AI simulator generates reports and reacts to the student's actions (for example, if he has chosen a capital structure that is too risky, the "game" can introduce an unexpected crisis or a requirement for collateral from the lender). Studies confirm that simulation-based learning increases engagement and the quality of learning, as it teaches through practice and errors in a safe environment [16]. AI plays a key role in this, ensuring the complexity and variability of scenarios, analyzing the actions of participants, and providing instant feedback. It is known that immediate feedback significantly speeds up learning - the AI system can immediately point out to the student an erroneous decision, explain the consequences, and suggest trying a different approach [16]. Such capabilities would be difficult to implement with the help of a human teacher or standard software alone.

Professional financial education includes the development of analytical thinking skills, working with big data, and building models. Modern data analysis programs (based on machine learning) are integrated into training courses: students master them by solving training tasks. For example, an economist or financial analyst can be trained using a platform that contains real large datasets (economic tables or financial statements) and has built-in ML algorithms for forecasting indicators or assessing the financial risk of a company. The student is asked to create a model - AI helps with this by suggesting methods, checking the quality of the model, detecting overfitting, etc. This format combines finance training and at the same time familiarization with FinTech tools that meet current trends in the labor market. Ultimately, the graduate, in addition to theoretical knowledge, will have experience using AI/ML in financial tasks, which strengthens his professional trajectory.

It is important to emphasize that innovations (personalization,

adaptive platforms, simulators, AI analytics) do not exist separately from each other. Ideally, they are integrated into a single educational ecosystem. For example, a learning platform can combine adaptive theoretical modules and practical simulation games, track the student's progress, and an AI assistant will advise him throughout the entire learning journey. This is exactly the combination that the most progressive projects in the EdTech industry are aiming for. For Ukraine, the introduction of such systems into economic and financial education could be a step towards a new level of quality in specialist training, allowing to overcome the limitations of traditional education (distance or online learning, little time for individual work, etc.) and providing each student with an individual trajectory of competence development.

Despite the significant advantages that the introduction of AI into economic and financial education promises, there are many challenges.

The development and implementation of effective AI solutions for education is a difficult task. First, a high-quality dataset is needed for training algorithms: in the context of economic and financial education, these can be large databases of test questions, problem solutions, student performance profiles from previous years, etc. Collecting such a dataset and ensuring its relevance is difficult, especially in narrow domains of finance. Second, the development of specialized AI applications for education requires significant resources. Researchers note that the creation of domain-oriented intelligent learning systems (for example, for specific financial disciplines) is a great challenge, and often the development of such systems does not fully take into account the features of the educational process and student motivation [17]. In other words, there is a risk that a technically advanced product will not be pedagogically effective. Third, the accuracy and reliability of AI. If the system gives advice to students or checks their calculations, algorithm errors can lead to incorrect learning. For example, if a chatbot explains a financial concept incorrectly, the student will acquire a misconception. Therefore, it is technically necessary to solve the issue of verifying AI answers and using verified sources. New generative models have a tendency to make up (“hallucinations”), which is critically dangerous in educational applications. Another aspect is the compatibility of AI tools with existing systems. Many universities use certain platforms (Moodle, Google Classroom, etc.); integrating AI modules there is not always a trivial task. Finally, a technical challenge is cybersecurity: educational AI systems must be protected from hacking and manipulation (for example, so that students cannot “cheat” the adaptive system or gain unauthorized access to

answers).

Ethical challenges - the introduction of artificial intelligence into education raises a significant range of ethical issues, with one of the more popular being privacy and data protection. Adaptive learning systems collect a lot of personal information about students: test results, behavioral data (what and how long they read, which mistakes they made), and possibly even biometric data (if facial expression or voice analysis is used). Ensuring reliable protection of this data and its use exclusively for educational purposes is critically important, and any leakage or misuse of student data is unacceptable. The second aspect is autonomy and the role of a person. If learning is too automated, the question arises: does the student (or teacher) lose control over the process, does constant control by the algorithm lead to a decrease in independence in learning, etc. Researchers directly indicate that ethical concerns have arisen regarding the restriction of student autonomy, since the algorithm can impose a certain learning trajectory [11]. It is important to ensure that AI is an assistant, not a "dictator" in learning: the student should retain the ability to choose, and the teacher should adjust the system's recommendations. The third ethical challenge is the bias of algorithms. If the data on which the AI is trained contains bias, then the recommendations or assessments of the AI may also be unfair. Imagine that the system decides, based on early successes, that a certain student is "weak" and starts giving him simplified tasks, thereby holding back his development – this is an unfair self-fulfilling prophecy. Algorithms must be carefully monitored for discrimination and bias. There are also questions of academic integrity: will AI not be used for fraud (for example, a student can ask ChatGPT to write an essay or solve a problem for him). Therefore, educational institutions should develop regulations in the field of ethical policy for the use of AI: what is allowed and what is not, how to monitor unethical behavior with the help of AI, how to educate students to have a responsible attitude towards such tools.

Legal regulation of artificial intelligence in education currently lags significantly behind the pace of technological development [5]. Many countries are just beginning to develop legislative norms and standards for the use of AI systems, and often these norms relate to critical areas (healthcare, transport, finance), but not directly to education. For Ukraine, steps towards adapting European approaches are relevant, in particular, taking into account the upcoming EU Regulation on Artificial Intelligence (EU AI Act), which introduces risk categories for AI systems. Educational systems with high autonomy may be classified as high risk, so the

requirements for transparency and certification of such systems will increase. Legal issues also include responsibility for learning outcomes: if, for example, an AI tutor gave the wrong advice, who is responsible – the software developer, the educational institution, or no one. The legal field here is still unclear. Similarly, intellectual property: content created by AI (for example, explanations, task texts) – who owns it, can it be freely used. In education, this is less commercially significant, but if educational materials are generated by AI, the question of authorship arises. Another nuance is the legal protection of student data. In Europe, the GDPR is in force, which provides strong protection for personal data, and educational institutions must comply with it. Ukraine also has legislative acts on personal data, so any AI solution must comply with them. There is a separate issue of licensing and certification of educational AI products: should such systems undergo state expertise before being introduced into the educational process. Currently, this is an area for discussion and policy formation.

To implement artificial intelligence in financial education, a certain technological infrastructure is required, in particular, access to the Internet, the presence of computers or devices in students, powerful servers or cloud services for the operation of AI algorithms. Unfortunately, digital inequality exists and not all institutions or students have equal opportunities, especially schools and universities in remote regions and rural areas. The risk is that the implementation of AI solutions may inadvertently widen the gap between “rich” and “poor” educational institutions if equal access is not ensured [5]. That is, modern schools will be able to afford modern technologies, while less resourced ones will not, which will put their students in unequal conditions. For Ukraine, this is a significant issue that should combine innovations with infrastructure development programs (for example, state investments in computer classroom equipment, provision of network Internet in all educational institutions, etc.). Another infrastructural point is the training of teachers. The teaching staff is also part of the “infrastructure” of the educational process. Many current teachers do not have the skills to work with AI or are even skeptical of such innovations, so a big challenge is to train teachers themselves to use AI tools, to form their digital competencies, which, in turn, requires time, advanced training programs, motivation, etc. The language issue can also be called infrastructural: most modern educational AI systems are developed in English. To implement them in Ukrainian educational practice, localization is necessary - translation of interfaces, adaptation to Ukrainian programs, filling with content in Ukrainian. This requires additional efforts and

resources, but without this, it will be more difficult for students to use the systems, and the effectiveness of learning will decrease. In summary, the implementation of AI in economic and financial education is an important task that requires taking into account many of the listed challenges. As UNESCO notes, technological progress in the field of AI is currently ahead of the development of policies and regulatory frameworks [5], so it is very important to "catch up" in regulation and infrastructure preparation. A human-centric approach to artificial intelligence is needed, that is, when the good of the student and society remains at the center, and technology serves as a tool, not an end in itself. Only under such conditions can the vectors of strengthening financial education through AI be implemented without negative consequences.

Conclusions.

The analysis shows that professional economic and financial education requires changes under the influence of modern challenges and opportunities. Financial literacy of the population is today recognized as a critically important component of national interests: it contributes to economic growth, financial stability, social cohesion and competitiveness of the state. For Ukraine, as for many other countries, increasing the level of financial education of citizens is a strategic priority, enshrined in state programs and supported by research demonstrating a direct relationship between financial awareness and the well-being of society.

At the same time, in the period of digital transformation, new vectors of reinforcement are opening up for education thanks to the introduction of artificial intelligence. Personalized learning trajectories, adaptive platforms, intelligent assistants, simulators of real financial situations allow to significantly increase the efficiency of learning, make it flexible, interesting and close to practice. The experience of the first implementations of AI technologies in education shows an increase in student motivation and improvement of learning outcomes provided that a competent combination of a human-oriented approach and technologies is used [17]. In other words, AI can become a powerful digital tool in training a new generation of specialists who will be well adapted to work in complex and dynamic markets.

However, like any innovation, the implementation of AI has challenges. Technical difficulties in development, ethical issues (from data privacy to preserving the role of the human), gaps in legal regulation and inequality of access to technology - all this requires a systemic solution. At the state level, a general strategy for integrating AI into education should be

developed, which would take into account both the potential for improving the quality of education and risks. It is necessary to establish standards for the ethical use of AI in education, guided by international developments (UNESCO principles, OECD projects, etc.). Part of such a strategy should be the updating of educational standards for financial and economic specialties with an emphasis on digital competencies and the ability to work with AI tools. Higher education institutions should actively experiment with pilot projects for the implementation of AI platforms in education, which can be in the format of courses using adaptive systems, the introduction of economic and financial simulations into the educational process, the creation of chatbots-consultants for students, etc. It is important to monitor and scientifically substantiate the effectiveness of such innovations in order to accumulate our own experience and adjust our approaches. It is also important to invest in teacher training (training, seminars on digital technologies, in particular on the opportunities and threats of AI). The teacher must understand how basic AI tools work, how they can be applied in classes, and most importantly, how to teach students to use them wisely. The success of the implementation of innovations will largely depend on the motivation and training of the teachers themselves.

In the context of national educational policy, it is important to ensure equal access to the latest technologies, that is, in parallel with the digitalization of education, it is necessary to strengthen the material and technical base of educational institutions: provide fast Internet, update computer equipment, create open resources and platforms in the Ukrainian language. Cooperation with IT businesses and international donors can accelerate this process by providing schools and universities with the necessary tools. It is also worth continuing scientific research at the intersection of pedagogy, economics, and computer science to track the results of implementing AI in education, share best practices with other countries, and assess long-term consequences. Interdisciplinary teams should investigate how the quality of financial education is changing under the influence of AI, what adjustments should be made to programs so that graduates have relevant skills (including skills for working with AI systems).

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