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PROJECT-BASED RESEARCH ACTIVITY INTEGRATION IN THE ERA OF ARTIFICIAL INTELLIGENCE AS A MECHANISM FOR DEVELOPING 21ST-CENTURY SKILLS AND COMPETENCIES AMONG FUTURE SPECIALISTS

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Abstract. At present, the issue of training specialists who possess project-based approaches to professional activity is becoming increasingly relevant in the country. Education has entered an era in which the key factor of a specialist's professional viability is not only the acquisition of knowledge, but also the ability to design educational processes based on data, technologies, and artificial intelligence. This article considers the psychological and pedagogical conditions for forming project competence among students of pedagogical higher education institutions in the context of integrating the project-research activities of future specialists using artificial intelligence. The mechanisms for integrating artificial intelligence tools into the educational process are revealed in order to develop students' skills in analyzing, modeling, and implementing pedagogical projects. The study substantiates the need to address this problem due to the following factors: first, all spheres of modern society, under conditions of a high level of project-organizational culture, presuppose the development and implementation of projects—in the production of material values, culture, science, and others. Special attention is paid to the formation of a research and reflective culture in the future teacher, as well as the ability to use artificial intelligence as a means to increase the effectiveness of creative and project activities.

The article substantiates the need to revise traditional teaching methods and transition from knowledge transmission to creating an environment for self-design and intellectual interaction between humans and machines. Since the article is devoted to one of the significant problems of forming cognitive competence, it provides justification for the research activity of future specialists and also describes the experience of organizing students' project activities based on artificial intelligence.

The article analyzes the potential possibilities of applying neural network–based artificial intelligence as a means of forming universal and general professional competencies among students of pedagogical higher education institutions in the course of educational-research and project activities. The

relevance of introducing artificial intelligence into the professional training of future teachers is justified, and its influence on the development of competencies stipulated by the State Educational Standard of the Republic of Kazakhstan in the field of artificial intelligence is analyzed. Based on differentiating the stages of project-research activity, the functions of artificial intelligence that are expedient for use are identified, and the degree of their application is established from the perspective of competency formation. The results of an expert assessment are presented, demonstrating that artificial intelligence is capable of efficiently performing routine everyday tasks, freeing up time for creative and analytical work.

Keywords: project competence, pedagogical project activity, digitalization of education, competency-based approach, artificial intelligence tools, teacher self-development, educational innovations, project method, project activity, neural network

Introduction

Modern education is experiencing an era of transformation comparable in scale to past industrial and digital revolutions. However, the essence of these changes lies not in technological progress, but in a deep reconsideration of the role of the individual in a world where the boundaries between knowledge and action, learning and creativity rapidly blur.

Within the State Educational Standard, a substantial share of future specialists' core professional competencies is formed through students' active engagement in project-based creative work, supported by a partnership between learners and teachers. Project activity develops students' ability to identify and address relevant psychological, pedagogical, didactic, and socio-cultural challenges. Among the wide range of innovative pedagogical approaches, the project method stands out as a basis for viewing teachers' project competence as an independent component of their general culture and professional competence.

A university is not a storehouse of knowledge; it is a laboratory of the future. Here, ideas do not repeat the past—they design the future. Instead of ready-made answers, the classroom produces a question: *what can we create ourselves?* For a future specialist, the ability to design is not merely a technological skill.

In pedagogical education today, a quiet but deep revolution is taking place. The teacher is no longer only an intermediary between knowledge and the learner. The digital era reinforces this process.

According to UNESCO (2023), more than 60% of higher education institutions worldwide have already integrated artificial intelligence tools into teaching and learning processes, which significantly transforms traditional pedagogical models. In addition, OECD (2022) reports emphasize that project-based learning increases the development of critical thinking, collaboration, and

problem-solving skills by up to 30–40% compared to traditional instruction. These findings indicate that the integration of artificial intelligence into project-based learning is not only a technological trend but also a pedagogical necessity.

Artificial intelligence does not remain merely a tool—it can construct teachers' cognitive learning models, predict educational scenarios, test hypotheses, and analyze the dynamics of students' development.

In accordance with the core ideas of the project-based paradigm in education, we consider the project competence of a primary school teacher as a set of knowledge, skills, and abilities, as well as personal qualities and psychological attitudes that are necessary and sufficient for the teacher to design a personal, developing educational environment. The project activity of a future primary school teacher is a pedagogical technology for creating and implementing pedagogical projects [1]. By its content, the project activity of a future specialist is creative—this is the conscious invention of primary school pupils together with the teacher, during which a tool for the practical solution of a personally or situationally significant problem is created, contributing to the development of systems thinking and revealing the designer's creative and cognitive potential.

Since the project method has a century-long history in foreign and domestic pedagogical practice, a large body of research can be identified that reveals the advantages of this technology in achieving didactic goals [2]. An analysis of philosophical, socio-cultural, and psychological-pedagogical scientific literature and applied studies in the use of project-based learning technology makes it possible to identify the main aspects of the issue under study.

Table 1. Conceptual statements of scholars who identified and studied aspects of integrating project-research activities based on AI

No.	*Conceptual statements*	*Researchers*
1	At the philosophical level, the value of project activity in forming a humanistic worldview, a holistic picture of the world, and systemic and creative thinking is revealed.	V.P. Ivanov, V.A. Ignatova, T.A. Pchelintseva, A.G. Lvova, K.E. Tsiolkovsky, A.E. Chuchin-Rusov
2	At the socio-cultural level, the possibilities of social design in the development of civil society are explored.	N.A. Aitov, G.A. Antonyuk, V.I. Kataeva, Yu.A. Kryuchkov, V.A. Lukov, etc.
3	At the psychological-pedagogical level, issues of personal and professional self-realization in project activity are considered and actively developed.	A.N. Bondarets, M.V. Borisovskaya, N.V. Igoshina, S.P. Kaneva, S.I. Solodovnikova, E.V. Strikacheva, G.V. Timonina, V.V. Shchegol, etc.
4	Tools for forming the future teacher's project culture as a component of professional competence.	L.A. Filimonyuk

5	Research devoted to studying the essence of pedagogical design and learners' project activity. Main directions include designing professional pedagogical education.	V.A. Bolotov, M.P. Gorchakova-Sibir, G.I. Ibragimov, E.I. Isaev, I.A. Kolesnikova, A.A. Orlov, V.I. Slobodchikov, N.A. Shaidenko, etc.
6	Pedagogical design using AI effectively in a teacher's professional activity.	G.I. Kovaleva, L.D. Morozova, V.M. Monakhov, A.V. Nizhnikov, T.K. Smykovskaya, etc.
7	Project activity as a tool for forming a future teacher's professional competence.	V.G. Veselova, N.N. Golovina, G.A. Demakova, N.E. Trofimova, L.A. Filimonyuk, etc.
8	Specific features of organizing project-based learning in higher education using AI.	N.G. Alekseev, G.A. Antyukhov, E.V. Boldyrev, Yu.V. Garagulya, Yu.V. Gromyko, L.M. Kurbatova, N.V. Klyueva, L.V. Ivanova, I.V. Pastukhova, V.V. Rubtsov, etc.
9	Educators who developed the project-based educational paradigm.	N.G. Alekseev, V.V. Davydov, J. Dewey, Yu.V. Gromyko, E.I. Isaev, W.H. Kilpatrick, A.A. Orlov, V.V. Rubtsov, V.I. Slobodchikov, S.T. Shatsky, K.D. Ushinsky, K.E. Tsiolkovsky, and others.
10	Ideas of the project paradigm; general principles of humanistic pedagogy.	N.G. Alekseev, G.I. Ibragimov, I.A. Kolesnikova, Yu.A. Kryuchkov, V.A. Lukov, K.N. Polivanova, N.E. Saurenko, N.E. Trofimova, L.A. Filimonyuk, V.A. Yasvin, etc.; and Sh.A. Amonashvili, E.V. Bondarevskaya, G.D. Gleizer, V.I. Zagvyazinsky, V.S. Stepin, etc.
11	Key ideas in educational philosophy and pedagogy methodology.	M.V. Boguslavsky, V.I. Belov, O.S. Gazman, S.I. Hessen, B.S. Gershunsky, V.V. Grachev, S.S. Gusev, V.A. Ignatova, V.V. Kraevsky, S.V. Kulnevich, A.A. Orlov, V.V. Rubtsov, V.I. Slobodchikov, N.M. Talanchuk, I.D. Frumin, A.E. Chuchin-Rusov, etc.
12	The methodological basis of the research is the principles of the systems approach.	I.V. Blauberg, A.N. Uemov, E.G. Yudin, etc.

Despite the significant contribution of domestic scholars to the development of project-based learning theory, the analysis of the literature shows that contemporary international research on the application of artificial intelligence in education remains underrepresented in the theoretical framework of this study.

Recent global studies emphasize that artificial intelligence is increasingly used not only as a supportive tool but also as an adaptive learning system capable of personalizing educational trajectories, supporting formative assessment, and enhancing students' metacognitive skills. For example, international research highlights the effectiveness of AI-driven platforms in improving students' engagement, learning analytics, and individualized feedback mechanisms in higher education contexts.

However, the integration of these findings into the context of teacher education and project-based pedagogical training remains insufficiently explored, which indicates a research gap and strengthens the relevance of the present study.

During the study, a contradiction was identified between: (1) the importance of the primary school teacher's project competence as a necessary component of professional-pedagogical competence determining the success of developing a socially active, intellectually developed, morally educated primary school pupil; and (2) the limitations of scientifically grounded pedagogical technologies for forming such competence in contemporary higher pedagogical education.

From a theoretical perspective, this is the problem of constructing and scientifically substantiating a model for forming future teachers' project competence in higher education [4]. From a practical perspective, it is the problem of identifying pedagogical conditions that ensure successful formation of future teachers' project competence in the higher education process.

Based on an analysis of the literature, we identified the following tools for project-research activities of future specialists of the twenty-first century in the era of artificial intelligence:

1. The content of the concept of integrating project-research activities in the era of AI has been defined.

2. Criteria (socio-cultural, psychological, pedagogical) and level characteristics of the project competence of a primary school teacher within AI-based integration of project-research activities are presented:

a) the level of value consciousness necessary for consciously choosing social and personal values and building a stable, consistent personal system of orientations that regulates motivation and self-control of behavior and actions in the project;

b) the level of intellectual development necessary to synthesize knowledge from different areas in project activity;

c) the level of theoretical knowledge and practical skills needed to organize learners' project activities through the development of participants' consciousness, intellect, and culture.

3. Structural components of the primary school teacher's project competence within AI-based integration of project-research activities are identified. The structure includes three components:

- socio-cultural (professional and life experience of conscious creativity);
- psychological (a set of professional and personal qualities determining productivity of the teacher's project activity jointly with pupils);
- pedagogical (a complex of professional knowledge, skills, and abilities necessary for effective goal-setting, modeling, planning, and reflective evaluation of learners' project activity).

4. A model for forming the project competence of future primary school teachers was developed, based on integrating systems, cultural, activity-based, axiological, personal, competency-based, and contextual methodological approaches, using students' collective distributed project activity while solving interdisciplinary project tasks.

Materials and methods

To achieve the objectives and goals of the research, the following theoretical and empirical methods were used:

Theoretical: systematic analysis of philosophical, psychological, pedagogical, and scientific-methodological literature; general scientific methods—comparison, juxtaposition, generalization, modeling.

Empirical: observation, expert evaluation method, questionnaire, testing, analysis of students' activity products, experimental method.

Statistical processing of experimental data: Spearman's linear correlation coefficient; Fisher–Snedecor analysis of variance; Student's method; φ* criterion—Fisher's angular transformation.

The experimental study was organized in several consecutive stages, ensuring methodological consistency and reliability of the obtained results. At the first (diagnostic) stage, baseline data on students' project competence levels were collected using standardized assessment tools, including questionnaires, testing, and expert evaluation sheets. The participants were divided into experimental and control groups to ensure comparative analysis.

During the formative stage, the developed model of integrating artificial intelligence into project-based and research activities was systematically implemented in the educational process. Students in the experimental groups were engaged in structured learning activities that included the use of AI tools at different stages of project work, while the control group followed traditional instructional methods without AI integration.

Data collection was carried out continuously throughout the experiment, including analysis of students' project outputs, observation of learning activities, and expert assessment of competencies.

The final stage involved quantitative and qualitative data processing. Statistical analysis was conducted using Spearman's correlation coefficient, Student's t-test, and Fisher's angular transformation (φ* criterion) to determine the significance of differences between experimental and control groups. The interpretation of results was based on comparative analysis of initial and final indicators, allowing the identification of statistically significant improvements in the level of project competence among students in the experimental groups.

The validity of the research results is ensured by: methodological soundness; comprehensive consideration of the research object at theoretical and practical levels in terms of its essential, structural, and functional characteristics; use of an adequate set of methods aligned with the aim, object, subject, and objectives; duration and replicability of experimental work achieving positive results in forming project competence of future primary school teachers; and statistical reliability of results.

The study was conducted at the Kazakh National Women's Teacher Training University; a total of 98 students participated.

Indicators of the level of pedagogical activity development, tools for assessing the individual level of teachers' demonstration of pedagogical competencies in project activity with learners, an assessment form, a key for

calculating the minimum level of mastery of project activity competencies (abilities) for teachers, and a diagnostic methodology were proposed.

Based on the methodology of A.A. Rean and V.A. Yakunin (modified by N.Ts. Badmaeva), a three-module educational-methodological package for forming project competence of future primary school teachers in the professional training process in higher education was developed:

1. "Methodology and Theory of the Teacher's Design Activity";
2. "Psychological Foundations of the Teacher's Project Competence";
3. "Organization and Technology of Primary School Pupils' Project Activity";

as well as summary tables for comprehensive assessment of the level of project competence formation at different stages.

In analysis of the collected data, descriptive analysis and content analysis of open-ended questions were conducted. Open-ended questions enabled identification of competencies formed in future specialists when integrating project-research activities in the era of AI.

Results and Discussion

One important direction of a teacher's professional activity is preparing learners to participate in research projects. Currently, artificial intelligence, including AI competency, generates significant interest in the competency formation process [4]. In S.Ya.Akhmizova's work, a methodology for using ChatGPT in forming communicative competence of linguistics students is presented [5]. The studies of O.A.Kozlov and M.E. Menzhevitsky focus on developing methods for forming digital competence using artificial intelligence technologies and neural networks [6]. However, the issue of how AI tools affect the formation of universal and general professional competencies of future teachers has not been sufficiently examined.

The relevance of the present study is related to investigating the formation of universal and general professional competencies of future teachers while implementing educational-research and project activities using neural networks.

Actions performed by students at each stage make it possible to form universal and general professional competencies. The correspondence between students' actions and the competencies formed is presented in the table below.

1. based on comparing activity stages and formed competencies, the following conclusions can be drawn:

Table 2. Correspondence between students' actions and the competencies formed

Stage	*Action at the stage of project and educational research activities*
Organizational and preparatory stage	Selecting a project or research topic
	Formulating the problem and identifying the relevance of the topic
	Defining the goals and Objectives of a project or research

	Defining the goals and objectives of a project or study
	Drawing up a preliminary work plan
	Formation of working groups (in case of group activities), distribution of roles within the group
	Selection of necessary literature and sources
Planning stage	Development of a project or research concept
	Drawing up a detailed action plan
	Selection of methods and forms of work
	Selecting the form of presentation of the project result
Research (search and analytical) stage	Search for information in scientific literature, Internet resources, databases
	Conducting observations, experiments, surveys, etc..
	Analysis, systematization and generalization of the collected material
	Identifying cause-and-effect relationships
	Consultation with the project manager
Technological stage (implementation stage)	Processing collected information and integrating it into the product
	Creation of a project product: report, presentation, model, video material, etc..
	Text design, structuring
	Корректировка промежуточных реЗультатов
	Adjustment of intermediate results
Presentation stage	Preparing a speech and materials for the presentation
	Demonstration of the project product to the audience
	Answers to questions and justification of decisions taken
Reflexive-evaluative stage	Collective and individual discussion of the project results
	Self-assessment and mutual assessment of project participants
	Analysis of the success of achieving the goals and objectives of the project
	Receiving feedback from a teacher or expert group
	Identifying prospects for further work

The role of AI in various fields of human activity is rapidly increasing, including major areas such as economics, healthcare, administration, and education. In education, AI becomes not only a tool for automating everyday processes, but also an active instrument supporting learners' educational-research and project activities.

Using neural networks at different stages of research activity opens new aspects in teacher preparation. This makes it especially relevant to purposefully form pedagogical directions for developing skills in using neural network technologies at the level of students' professional competence [5,6,7].

Based on the analysis of studies devoted to students' and schoolchildren's project and educational-research activities, the following stages and actions can be distinguished:

1. Organizational-preparatory stage: choosing a project/research topic; formulating the problem and relevance; defining goals and objectives; formulating

a hypothesis; drawing up a preliminary plan; forming work groups (if group work); distributing roles; selecting literature and sources.

2. Planning stage: developing a concept; drawing up a detailed plan; selecting methods and forms of work; choosing the form of presenting the project result.

3. Research (search-analytical) stage: searching for information; conducting observations/experiments/surveys; analyzing, systematizing and generalizing material; identifying cause-and-effect; consulting with a supervisor.

4. Technological (implementation) stage: processing and integrating information into a product; creating the product (report, presentation, model); text design and structuring; adjusting intermediate results; consulting with a supervisor.

Table 2. The use of AI at the stages of educational, research and project activities of students

Stages of project and educational research activities	*Function of neural networks*	*Examples of neural networks*
Organizational and preparatory stage	Selection of literature, analysis of documents, summarizing scientific articles, development of a preliminary work plan	Research Rabbit, Semantic Scholar, DeepSeek
Planning stage	Drawing up a detailed plan, generating general research methods and possible forms of presentation of the project results	DeepSeek, YandexGPT, Qwen, Bearly
Research (search and analytical) stage	Analysis, systematization and generalization of collected information	Semantic Scholar, Bearly, DeepSeek
Technological stage (implementation stage)	Generating examples, tasks, and tests Code writing. Text translation. Creating diagrams, graphs, and charts.	DeepSeek, YandexGPT, Qwen, ruGPT
Presentation stage	Generation of videos, presentations and speech texts	DeepSeek, YandexGPT, Qwen
Reflective-evaluative stage	Generating development prospects for the topic	DeepSeek, YandexGPT, Qwen

1. General professional competency is formed mainly at stages associated with group work, coordination of actions, self- and peer-assessment, and receiving feedback.

2. Some activities (forming work groups, distributing roles, consulting with a teacher, and reflection) contribute to the formation of two competencies at once - which indicates their special role in the structure of project and research work.

The data presented in the table served as the basis for implementing the next research objective—analyzing the functions of neural networks used at different stages of educational-research and project activity.

Table 2 presents the functions and examples of neural networks used in completing tasks within the subjects and practicum of the module on students' educational-research and project-based activities. The selection of these neural networks is based on their functionality, accessibility, and practical application experience.

The selection of these neural networks was based on their functionality, accessibility, and practical experience of use. Based on the data presented in Table 2, it can be concluded that neural networks have significant potential to support all stages of project and research activities.

At the next stage, an expert assessment was conducted to determine at which stages it is most effective to use neural networks in order to form students' competencies across all stages of educational-research and project activity. According to research by a team led by S.A. Zaitseva [12], competencies are formed only through activity; therefore, experts were asked to evaluate the use of neural networks (Research Rabbit, Semantic Scholar, DeepSeek, YandexGPT, Qwen, etc.) from the perspective of involving students in such activity.

The expert group included lecturers and students of Kazakh National Women's Teacher Training University who organize project and educational-research activities (total experts:8).

Based on the obtained data, conclusions can be drawn about the feasibility of using neural networks at different stages:

1. AI should be used at stages associated with routine and technical tasks (selecting literature, processing and visualizing data, structuring text). These actions require significant time, but are not directly tied to competency formation. Using neural networks here frees time for creative and analytical work.
2. AI can be used to a moderate extent to support competency formation (selecting methods/forms of work, adjusting intermediate results, identifying prospects). In these cases, the neural network can act as an assistant offering options, but final decisions must remain with the student.
3. Using neural networks is inappropriate at stages requiring reflection and social interaction (describing the methodological apparatus, forming groups and distributing roles, creating the project product, analyzing results and reflecting). Competencies develop precisely at these stages; transferring these tasks to a neural network prevents the formation of the needed competencies.

Table 5. Expert assessment of feasibility of using AI at the stages of design and educational-research activities

Action at the stage of project and educational research activities	*Level of feasibility of using AI*	*Justification of feasibility*
Organizational and preparatory stage		
Selecting a project or research topic	Short	The topic should reflect the student's interests. A neural network can provide ideas, but the student must make the choice.

Formulating the problem and identifying the relevance of the topic	Average	A neural network helps identify gaps, but formulating a problem requires analytical thinking and independence.
Defining the goals and objectives of a project or study	Average	The neural network can suggest options, but the final formulation must be completed by the student.
Formulation of the hypothesis	Short	A hypothesis can be formulated by a neural network, but independent formulation of a hypothesis contributes to the development of analytical, critical and creative thinking of the student.
Drawing up a preliminary work plan	High	Planning is a routine task. A neural network can help structure work, freeing up time for creative tasks.
Formation of working groups (in case of group activities), distribution of roles within the group	Short	Social interaction and distribution of roles are an important part of the formation of professional competencies of a teacher, therefore the use of a neural network is inappropriate
Selection of necessary literature and sources	Very tall	Information search is a routine task. Neural networks significantly speed up the selection of literature.
Planning stage		
Developing a project or research concept	Short	Concept development requires creativity, systems thinking, and deep understanding. Transferring this process to a neural network is impractical.
Drawing up a detailed action plan	High	Detailing the plan is a technical task. The neural network ensures automation of this process.
Selection of methods and forms of work	Average	The neural network can generate general methods and forms of work without taking into account the specifics of the project. The final choice of methods must be made by the student.
Selecting the form of presentation of the project result	Average	A neural network can help with the selection of stylistic examples and templates, but adaptation to a specific audience remains the responsibility of the student.
Research (search and analytical) stage		
Search for information	Very tall	Searching for information is a routine task. Automating the search will allow the student to focus on data analysis.
Conducting observations, experiments, surveys, etc.	Short	These actions require the direct participation of the researcher.
Analysis, systematization and generalization of the collected material	Average	The neural network helps to structure the information, but the interpretation and conclusions must be made by the student.
Identifying cause-and-effect relationships	Short	This action promotes the development of logical, analytical, and critical thinking. The use of a neural network is inappropriate.

Consultation with the project manager	Short	The project should be managed by a teacher, not a neural network.
Technological stage (implementation stage)		
Processing the collected information and integrating it into the product	High	Data summarization is a routine task that a neural network can perform.
Creating a project product	Short	The neural network copes well with this type of work, but its use does not contribute to the formation of professional competencies in students.
Text design, structuring	High	Text editing is a routine task. A neural network helps improve the structure and style of the text, which saves time.
Adjustment of intermediate results	Average	The neural network can point out inaccuracies in the results obtained, but the student is responsible for the reliability of the results.
Consultation with the project manager	Short	The project should be managed by a teacher, not a neural network.
Presentation stage		
Preparing a speech and materials for the presentation	High	Preparing a presentation is a routine task that a neural network can perform.
Demonstration of the project product to the audience	Short	The demonstration of the project result should be carried out by the student, not by the neural network
Answers to questions and justification of decisions taken	Short	Answers require critical thinking, understanding the essence and the ability to defend one's point of view. The use of a neural network is inappropriate.
Reflective-evaluative stage		
Discussion of the project results	Short	Using a neural network is impossible
Self-esteem and mutual esteem	Short	Using a neural network is impossible
Analysis of the success of achieving the goals and objectives of the project	Average	A neural network can evaluate the fulfillment of the project's goals and objectives, but its use does not contribute to the development of a student's analytical and critical thinking.
Receiving feedback from the teacher	Short	Using a neural network is impossible
Identifying prospects for further work	Average	The neural network can offer general recommendations, but the student must choose specific directions.

Thus, this study analyzed the degree of purposeful appropriateness of using neural networks in forming competencies during educational-research and project activities of pedagogical university students. The link between competencies and students' actions across all stages of such activity was established. Neural networks were found to have high potential in organizing students' educational-research and project activities and thus influence competency formation.

The use of neural networks in organizing educational-research and project activities of pedagogical university students should be balanced. It is important to remember that competence is formed through the student's active work. Therefore, students should be taught to maintain an active position in project and research activities, approach results critically, and verify their correctness.

The teacher's role remains decisive when introducing AI into the educational process. The teacher must guide students in using neural network technologies, teach ethical and responsible AI use, and ensure a balance between automation and the development of independent thinking. Teacher training programs should include sections devoted to working with neural networks, including practical training and ethical AI use.

The project competence of a primary school teacher, as an integral characteristic of personality, determines the orientation of project efforts in pedagogical activity. The basis for differentiating levels of primary school teachers' project competence is a set of indicators:

- the level of intellectual development needed to synthesize knowledge from different areas;
- the level of value consciousness necessary for conscious choice of social and personal values and for constructing a stable system of orientations regulating motivation and self-control;
- the level of theoretical knowledge and practical skills needed to organize learners' project activity through developing participants' consciousness, intellect, and culture.

Determining the essence, structure, and components of a primary school teacher's project activity served as the basis for creating a model of forming project competence of future primary school teachers based on AI in the higher education professional training process (Figure 1).

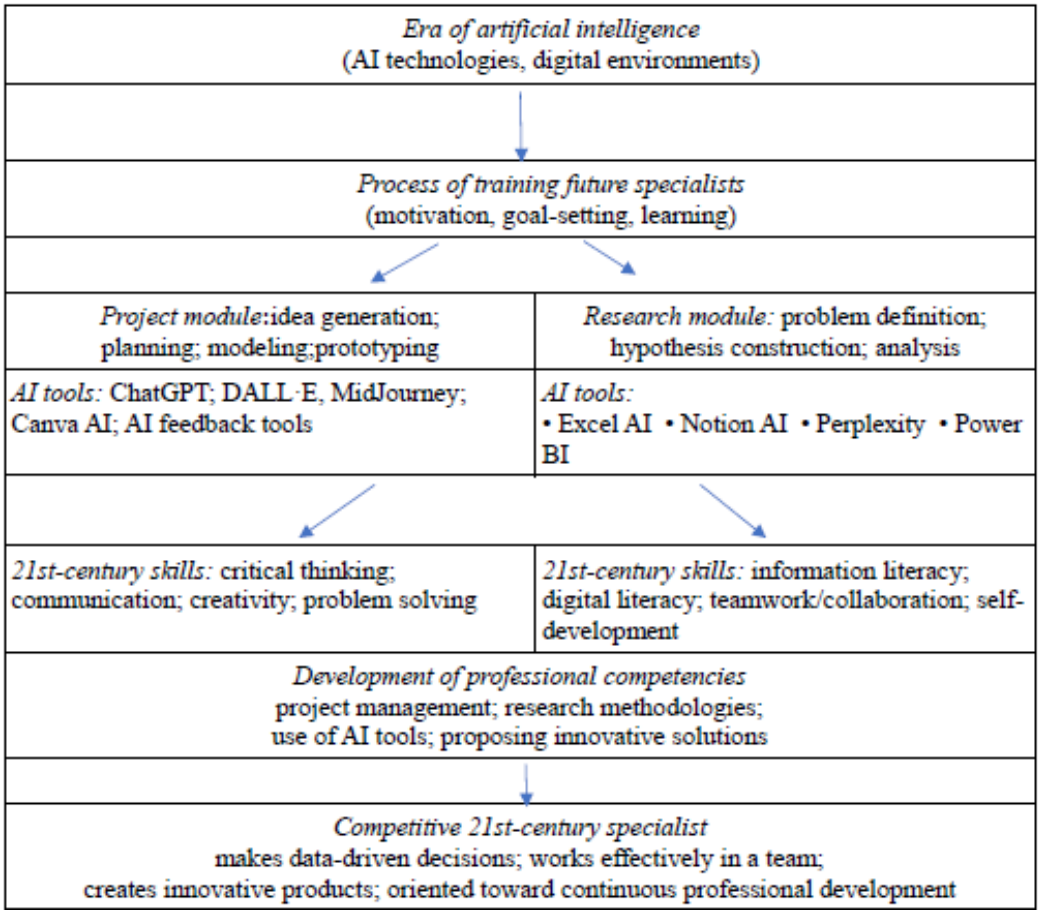

Figure 1. Conceptual model of integrating project-research activity of future specialists in the era of AI (expanded)

The proposed model can be described as structural, dynamic, and deterministic.

Pedagogical conditions contributing to effective functioning of the model for forming project competence of future primary school teachers based on AI in the professional training process in higher education include:

1. Creating a project-development environment in the educational space of the university through a cycle of special events aimed at актуализация (actualizing) students' need to master project competence and forming the ability to use project competencies in future professional-pedagogical activity using AI.
2. Ensuring methodological support for forming project competence through creating an educational program that meets the requirements of interdisciplinary interaction and modular program design.

The experimental work was carried out in three stages.

At the first (ascertaining) stage, diagnostic tools were developed and diagnostics were conducted to determine the level of project competence of

participants. Thus, three experimental groups and one control group were identified.

The formative stage involved implementing the model into the university professional training process, creating a project-development environment, implementing a set of pedagogical conditions for forming project competence of future primary school teachers, and ensuring a system for monitoring compliance during testing of the experimental program.

The third stage (analytical-result stage) included final control diagnostics of students' project competence according to identified criteria and indicators; comparison with data from the ascertaining stage; analysis, evaluation, generalization of results; and formulation of key conclusions aligned with the research goals and objectives.

Analyzing the results of the experimental work with students, we observed the dynamics of forming project competence of a primary school teacher based on AI across three criteria: socio-cultural, psychological, and pedagogical. At the end of the experiment, in the control group the number of students with a high level of project competence remained at the ascertaining stage level (14.3%), while the number with an average level slightly increased (from 25% to 32.2%). Accordingly, the number of students with a low level decreased by 7.2%.

The experiment ensured effective formation of teachers' project competence based on AI in the professional training process in higher education. Figure 2 shows the ratio in level distribution of the integral indicators of project competence among students of the four observed groups (n = 109).

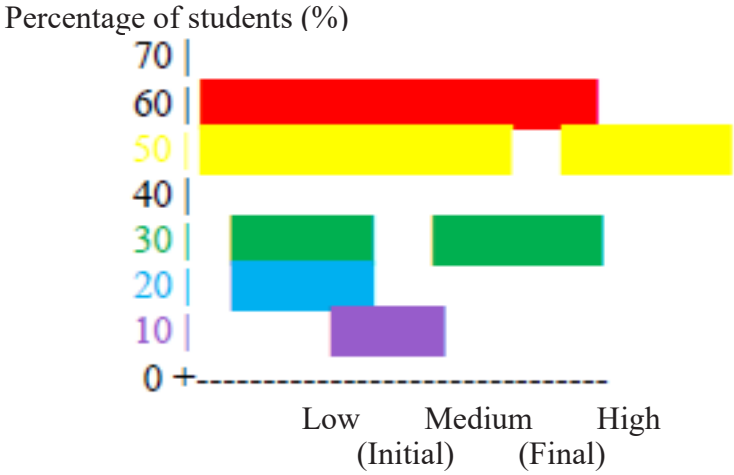

Figure 2. Ratio of control and experimental groups in level distribution of project competence indicators, n = 109.

At the final stage of the experiment, the high level of project competence was mainly achieved by students in the experimental groups. The low level across the overall sample was represented by students in the control group. The scientific

literature on teacher professional training indicates that personal qualities can be developed through the formation of professional skills. In the experimental educational program, we revised requirements for teachers' knowledge, skills, and abilities in project activity, which serve as a basis for developing certain personal qualities. Studying and mastering the program modules positively influences the development of didactic, communicative, emotional, volitional, and moral qualities.

To substantiate the reliability of the data obtained during the experiment, methods of mathematical statistics were used (Spearman correlation coefficient; Fisher–Snedecor variance analysis; Student's method; φ* criterion—Fisher's angular transformation).

Experimental verification of the effectiveness of the proposed model led to the following conclusions:

1. Analysis of problems identified at the ascertaining stage depending on the initial level of project competence confirmed the relevance of forming project competence of future primary school teachers in the professional training process in higher education.

2. The control stage confirmed the real attainability of high results in forming project competence according to the criteria of its formation.

3. At the same time, despite the significant pedagogical potential of artificial intelligence in project-based and research activities, several important limitations and risks must be considered. First, the excessive reliance on AI tools may lead to a reduction in students' independent cognitive effort, resulting in cognitive dependency and weakening of analytical thinking skills.

4. Second, the use of AI raises issues of academic integrity, including the risks of plagiarism, uncritical acceptance of generated content, and reduced authenticity of students' individual contributions.

5. Third, ethical aspects of AI integration in education remain highly relevant, particularly in relation to data privacy, transparency of algorithms, and responsible use of generated information.

6. Finally, pedagogical limitations should be acknowledged: AI cannot fully replace reflective thinking, emotional intelligence, and value-based decision-making, which are essential components of professional competence in teacher education. Therefore, artificial intelligence should be considered as an assisting tool rather than a substitute for human intellectual activity. Maintaining a balanced approach between automation and human cognitive development is crucial for ensuring the effectiveness of project-based learning in higher education.

7. Conclusions about significant changes in levels of project competence formation in the professional training process in higher education and in the experimental groups are reliable.

8. The results demonstrate the viability, practical significance, and effectiveness of the proposed model.

Thus, the research hypothesis was confirmed, the goal was achieved, and the objectives were solved.

Conclusion

The present study examined the integration of project-based and research activities with artificial intelligence tools in the development of project competence among future primary school teachers. The results of the experimental work indicate positive dynamics in the formation of students' competencies across socio-cultural, psychological, and pedagogical criteria.

Quantitative analysis demonstrated that in the experimental groups the proportion of students with a high level of project competence increased, while the number of students with a low level decreased compared to the initial diagnostic stage. In contrast, changes in the control group were less significant, with only minor improvements observed in the average level of competence development.

Statistical processing of the data using Spearman's correlation coefficient, Student's t-test, and Fisher's angular transformation confirmed the reliability of the observed differences between the experimental and control groups. These results indicate that the integration of artificial intelligence tools into project-based learning has a statistically significant positive effect on the development of students' project competence.

At the same time, the effectiveness of the proposed model should be interpreted with caution. The obtained results are limited by the sample size and the context of a single higher education institution, which restricts the generalizability of the findings. Therefore, the conclusions regarding the effectiveness of the model should be considered within the scope of the conducted experiment.

Overall, the study confirms that artificial intelligence can serve as an effective supporting tool in organizing project-based and research activities in higher education. However, its impact is most significant when combined with active student engagement, guided pedagogical support, and a balanced approach that preserves the development of independent thinking and reflective skills.

Future research should focus on expanding the experimental base, including longitudinal studies, and examining the long-term effects of artificial intelligence integration on professional competence formation in teacher education.

It should be noted that the originality of the present study is primarily of an applied nature. The main scientific contribution lies in the systematic mapping of project-based learning stages to specific functions of artificial intelligence tools in teacher education. This structured alignment provides a practical framework for integrating AI into educational-research activities.

While the study does not propose a fundamentally new pedagogical theory, it contributes to the operationalization of existing project-based learning and competency-based approaches in the context of artificial intelligence. In this sense, the research extends current knowledge by offering a functional model that can be directly implemented in higher education practice for training future teachers.

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БОЛАШАҚ МАМАНДАРДЫҢ ЖАСАНДЫ ИНТЕЛЛЕКТ ДӘУІРІНДЕ ЖОБАЛАУ-ЗЕРТТЕУ ҚЫЗМЕТІН ИНТЕГРАЦИЯЛАУ: ХХІ ҒАСЫРДЫҢ ДАҒДЫЛАРЫ МЕН ҚҰЗЫРЕТТЕРІН ДАМЫТУ ҚҰРАЛЫ РЕТІНДЕ

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Аңдатпа. Қазіргі уақытта елімізде өзінің кәсіби қызметін жобалау тәсілдерін меңгерген маман даярлау мәселесі өзекті болып отыр. Білім маманның кәсіби өміршеңдігінің негізгі факторы ретінде тек білімді меңгеру ғана емес, сонымен қатар деректерге, технологияларға және жасанды интеллектке сүйене отырып, білім беру процестерін жобалау қабілеті болатын дәуірге енді.

Мақалада болашақ мамандардың жасанды интеллект арқылы жобалау-зерттеу қызметін интеграциясы контекстінде педагогикалық ЖОО студенттерінің жобалық құзыреттілігін қалыптастырудың психологиялық-педагогикалық шарттары қарастырылады. Студенттердің педагогикалық жобаларды талдау, модельдеу және іске асыру дағдыларын дамыту мақсатында жасанды интеллект құралдарын оқу процесіне интеграциялау тетіктері ашылады. Зерттеу жұмысымызда оны шешу қажеттілігі келесі фактілермен байланыстылығы айқындалған: біріншіден, қазіргі қоғамның барлық салалары, оның жобалық-ұйымдастырушылық мәдениетінің жоғары дамуына байланысты, жобаларды әзірлеу мен жүзеге асыруды білдіреді: материалдық құндылықтар өндірісі, мәдениет, ғылым және т. б. Болашақ мұғалімнің зерттеушілік және рефлексивті мәдениетін қалыптастыруға, ЖИ-ті шығармашылық пен жобалық қызметтің тиімділігін арттыру құралы ретінде қолдана білуге ерекше назар аударылған.

Мақала оқытудың дәстүрлі әдістерін қайта қарау, білімді беруден адам мен машинаның өзін-өзі жобалауы мен интеллектуалды өзара әрекеттесуі үшін орта құруға көшу қажеттілігін негіздейді. Мақала танымдық құзыреттілікті қалыптастырудың маңызды мәселелерінің біріне арналғандықтан, болашақ мамандардың зерттеу қызметінің негіздемесі келтірілген, сонымен қатар студенттермен ЖИ негізінде жобалық қызметті ұйымдастыру бойынша жұмыс тәжірибесі ұсынылған.

Мақалада оқу-зерттеу және жобалау қызметі барысында педагогикалық жоғары оқу орындары студенттерінің әмбебап және жалпы кәсіби құзыреттіліктерін қалыптастыру құралы ретінде нейрондық желілік жасанды интеллекті қолданудың әлеуетті мүмкіндіктері қарастырылады. Болашақ мұғалімдердің кәсіби дайындығына ЖИ енгізудің өзектілігі негізделеді, Қазақстандық ЖИ мемлекеттік білім беру стандартында қарастырылған құзыреттерді дамытуға әсері талданады. Жобалау-зерттеу қызметінің кезеңдерін саралау негізінде пайдалануға болатын ЖИ функциялары айқындалды және құзыреттерді қалыптастыру тұрғысынан оларды пайдалану дәрежесі айқындалды. ЖИ шығармашылық және аналитикалық жұмыстарға уақыт бөлу арқылы күнделікті тапсырмаларды тиімді орындай алатынын көрсететін сараптамалық нәтижелері ұсынылды.

Тірек сөздер: жобалық құзыреттілік, педагогикалық жобалау қызметі, білім беруді цифрландыру, құзыреттілік тәсіл, ЖИ құралдары, педагогтің өзін-өзі дамытуы, білім беру инновациялары, жоба әдісі, жобалық қызмет, нейрожелі

ИНТЕГРАЦИЯ ПРОЕКТНО-ИССЛЕДОВАТЕЛЬСКОЙ ДЕЯТЕЛЬНОСТИ БУДУЩИХ СПЕЦИАЛИСТОВ В ЭПОХУ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА: КАК ИНСТРУМЕНТ РАЗВИТИЯ НАВЫКОВ И КОМПЕТЕНЦИЙ XXI ВЕКА

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Аннотация. В настоящее время в стране актуализируется проблема подготовки специалистов, владеющих проектными подходами к осуществлению профессиональной деятельности. Образование вступило в эпоху, в которой ключевым фактором профессиональной жизнеспособности специалиста становится не только усвоение знаний, но и способность проектировать образовательные процессы на основе данных, технологий и искусственного интеллекта. В статье рассматриваются психолого-педагогические условия формирования проектной компетентности студентов педагогических высших учебных заведений в контексте интеграции проектно-исследовательской деятельности будущих специалистов с использованием искусственного интеллекта. Раскрываются механизмы интеграции инструментов искусственного интеллекта в

образовательный процесс с целью развития у студентов умений анализа, моделирования и реализации педагогических проектов. В исследовании обоснована необходимость решения данной проблемы, что связано со следующими факторами: во-первых, все сферы современного общества в условиях высокого уровня развития проектно-организационной культуры предполагают разработку и реализацию проектов — в производстве материальных ценностей, культуре, науке и др. Особое внимание уделяется формированию исследовательской и рефлексивной культуры будущего учителя, а также умению использовать искусственный интеллект как средство повышения эффективности творческой и проектной деятельности.

В статье обосновывается необходимость пересмотра традиционных методов обучения и перехода от трансляции знаний к созданию среды для самопроектирования и интеллектуального взаимодействия человека и машины. Поскольку статья посвящена одной из значимых проблем формирования познавательной компетентности, в ней представлено обоснование исследовательской деятельности будущих специалистов, а также описан опыт организации проектной деятельности студентов на основе искусственного интеллекта.

В статье анализируются потенциальные возможности применения нейросетевого искусственного интеллекта как средства формирования универсальных и общепрофессиональных компетенций студентов педагогических высших учебных заведений в процессе учебно-исследовательской и проектной деятельности. Обоснована актуальность внедрения искусственного интеллекта в профессиональную подготовку будущих учителей, проанализировано его влияние на развитие компетенций, предусмотренных государственным образовательным стандартом Республики Казахстан в области искусственного интеллекта. На основе дифференциации этапов проектно-исследовательской деятельности определены функции искусственного интеллекта, целесообразные для использования, а также установлена степень их применения с точки зрения формирования компетенций. Представлены результаты экспертной оценки, демонстрирующие способность искусственного интеллекта эффективно выполнять ежедневные задачи, высвобождая время для творческой и аналитической деятельности.

Ключевые слова: проектная компетентность, педагогическая проектная деятельность, цифровизация образования, компетентностный подход, инструменты искусственного интеллекта, саморазвитие педагога, образовательные инновации, метод проектов, проектная деятельность, нейросеть

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