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INNOVATIVE MODEL OF PROFESSIONAL TRAINING OF FUTURE CHEMISTS BASED ON QUEST-BASED TRAINING

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Abstract. This article presents a comprehensive analysis and modeling of the professional training process for future chemistry teachers using quest technologies as an innovative and effective tool for active learning. It emphasizes that, given the rapid digitalization of education and the updating of teacher education, quest learning is becoming a significant element of modern teaching methods. The theoretical and methodological foundations of quest technologies, their essence, structure, and pedagogical potential are examined within the context of a competency-based approach. A structural and functional model has been developed, including the key components, stages, and pedagogical conditions for the successful implementation of quests in the educational process, ensuring the comprehensive development of professional, research, and meta-subject competencies in future teachers.

A comparative analysis of domestic and international studies revealed common trends and development directions for quest technologies in teacher education. Particular attention is paid to the didactic potential of quests, their role in increasing student motivation, developing critical and creative thinking, teamwork skills, and independent work. It is noted that quests, as an integrative form of learning, combine game-based, research-based, information-based, and problem-based methods, creating conditions for students' active participation in the educational process.

The article describes in detail the implementation of quests in chemistry teacher training, including educational, research, and digital quests, as well as the organizational, technical, and methodological conditions for their effective integration into the educational environment. It concludes that quest technologies contribute to improving the quality of professional training for future teachers, developing their creativity, communication skills, and sustained motivation for professional work in the context of modern education.

Keywords: quest technologies, professional training, modeling, chemistry teacher, interactive learning, digitalization of education, pedagogical innovations, competence-based approach

Introduction

The modern teacher education system faces numerous challenges arising from the need to adapt curricula to the digital age and train teachers proficient in modern educational technologies [1]. One of the key areas of development is the development of professional competencies that prepare future teachers for

innovative work, as well as the development of critical thinking, creativity, and independence in students.

In this context, interactive learning methods are particularly important, with quest technologies playing a key role. Quests, which are game-based educational models, promote active student engagement, collaborative problem-solving, and deep immersion in the subject being studied. This is especially important when training future chemistry teachers - a subject that requires not only a solid knowledge of theory but also the ability to apply it in practice.

Despite the increased interest in quest learning, the challenge of systematically modeling professional training using it, identifying the advantages and potential limitations of this technology, and identifying the conditions for its effective implementation in the educational process remains relevant [2]. This article attempts to comprehensively analyze this problem based on a study of domestic and international experience and presents a model adapted to the specific needs of training future chemistry teachers in Kazakhstan.

Quest technologies in pedagogy represent a modern, innovative method of active learning based on the integration of game elements, research activities, and problem-solving. The essence of this approach lies in students completing sequential tasks (quests) step by step, each aimed at achieving a common educational goal. This organization of the learning process is closely aligned with the ideas of constructivist, activity-based, and competency-based approaches, which focus on actively engaging students in the learning process and the practical application of acquired knowledge.

Constructivist theory asserts that knowledge development occurs through the learner's active interaction with the environment and their independent solution of real-world problems [3]. Quest technologies, with their problem-oriented focus, promote the development of critical and independent thinking, as well as the ability to search for and analyze information [4].

In turn, the activity-based approach emphasizes the importance of learning activities as the primary means of personal and professional development, which is entirely consistent with the nature of quest learning, which involves reflection, collaboration, and the practical application of acquired knowledge.

Furthermore, modern research confirms that quest-based learning effectively implements the principles of a competency-based approach, aimed not only at mastering subject-specific knowledge but also at developing universal competencies-communication, digital skills, critical thinking, and the ability to self-educate. This is particularly important in the context of training future chemistry teachers, who must not only deeply understand the content of the subject but also master modern pedagogical methods that foster independence, research skills, and cognitive activity in students.

The scientific novelty of the study lies in the development and experimental testing of a structural and functional model for the professional training of future chemistry teachers based on quest technologies in the context of the digitalization of pedagogical education, including diagnostic tools for assessing meta-subject competencies.

Materials and methods

The study was based on an analysis of scientific papers and publications by domestic and foreign authors devoted to issues of professional training of teachers, the implementation of innovative educational technologies and the use of quest technologies in the educational process [5]. During work the study examined scientific and methodological sources reflecting areas of modernization in pedagogical education, the use of digital tools in teacher training, and reports from universities implementing interactive learning methods. Regulatory and strategic documents guiding the development of Kazakhstan's higher pedagogical education system were also reviewed, including concepts of digitalization and enhancing pedagogical potential. The study's methodological basis consisted of a historical and logical analysis, systematization, generalization, and comparative data analysis, which allowed the identification of key trends, current challenges, and prospects for integrating quest technologies into the professional training of future chemistry teachers [6].

Organization of a Pedagogical Experiment

The study was conducted at the Abai Kazakh National Pedagogical University. Twenty-eight students enrolled in the chemistry teacher training program participated in the study. They were divided into two groups: an experimental group (n=14) and a control group (n=14).

During the ascertainment phase, an initial survey was conducted to determine the students' baseline level of meta-subject competencies.

Over the course of one semester, the experimental group implemented a developed structural and functional model of professional training based on quest technologies. The training included the systematic use of educational, methodological, and digital quests, the organization of team project activities, and a reflective analysis of the results.

In the control group, the educational process was carried out using traditional teaching methods.

During the control phase, a repeat survey was conducted, along with pedagogical observation and analysis of the students' work products.

A comparative analysis of the results allowed us to identify the dynamics of the development of meta-subject competencies and evaluate the effectiveness of the developed model.

Diagnostic Tools

To assess the development of meta-subject competencies, a questionnaire was used. It included 20 statements divided into four sections: cognitive, regulatory, communicative, and personal-motivational competencies.

Assessment was conducted on a five-point Likert scale (from 1 - "never/disagree" to 5 - "always/completely agree").

Each section contained five statements, which allowed us to determine the degree of development of the corresponding competencies.

Additionally, pedagogical observation and student self-assessment methods were used, ensuring a comprehensive assessment.

The following methods were used in the study: theoretical analysis and synthesis of scientific literature on the implementation of quest technologies; pedagogical modeling in the development of a structural and functional model of professional training; student questionnaires; pedagogical observation; student self-assessment methods; comparative analysis of the results of the experimental and control groups. methods of quantitative data processing (calculation of average values of indicators before and after the experiment).

Results

Clearly defining goals and methods for achieving them creates the foundation for moving on to the educational process modeling stage, namely, developing a professional training model for future chemistry teachers using quest technologies. Effective implementation of this process is only possible with a well-thought-out and logically structured model that reflects current trends in teacher education and takes into account the specifics of developing professional competencies in future teachers. Developing such a model is essential for ensuring the integrity, consistency, and sustainable development of teacher training in the context of the digital transformation of the educational environment [7].

This study places particular emphasis on the concept of «model». In this context, a model is defined as a system-a mentally created or practically implemented construct that reflects the key characteristics of the pedagogical process being studied. Such a system serves as a proxy for the actual learning object, enabling it to be used to identify patterns, determine the structure, and evaluate the effectiveness of professional training for future chemistry teachers using quest technologies.

To effectively address this challenge, it is necessary to model the professional training process for future chemistry teachers using quest technologies. This approach entails organizing the educational process as a holistic pedagogical system aimed at ensuring maximum effectiveness at all stages of learning and developing key professional competencies in students.

Modeling the professional training process for future chemistry teachers using quest technologies means organizing this process into a logically interconnected system aimed at achieving the greatest pedagogical effect. Based on the principles of modeling as a scientific method and taking into account modern educational practices, we have developed a model for organizing the training of future chemistry teachers, incorporating the main structural components and stages of integrating quest technologies into the educational process. This model is presented in Figure 1 and serves as a methodological basis for further improvement and practical implementation of the professional training system.

The developed model of professional training for future chemistry teachers based on quest technologies includes several key blocks that ensure the integrity, consistency, and practical orientation of the educational process. Each block

performs a specific function in the development of professional competencies, contributing to the effectiveness of learning and to the active involvement of students in educational activities.

The *goal block* focuses on developing the professional competence of future teachers and fostering sustainable motivation for innovative pedagogical activity. It involves the development of skills related to designing, organizing, and implementing educational quests in the learning process, promotes interest in the teaching profession, and encourages professional self-improvement.

The *content block* integrates knowledge from chemistry, pedagogy, and information technologies into a unified system. It provides future teachers with a comprehensive understanding of the educational process, the principles of chemistry teaching, and the use of modern digital learning tools. This block contributes to the development of professional knowledge, methodological competence, and the ability to apply an interdisciplinary approach in teaching [8].

The *activity block* involves the active engagement of students in practical activities related to the development and implementation of educational quests, participation in group assignments, discussions, and reflective analysis. Such activities contribute to the development of communicative and research skills, creative thinking, and the ability to collaborate effectively in a team.

The *result-analytical block* evaluates the level of professional competency development among future teachers. It is implemented through a system of observation, self-assessment, and external evaluation, which makes it possible to determine the level of knowledge and skills acquired and to identify directions for further professional growth and improvement of teaching practice.

The interrelation and sequence of these blocks are presented in the structural-functional model of professional training of future chemistry teachers based on quest-based learning (Figure 1).

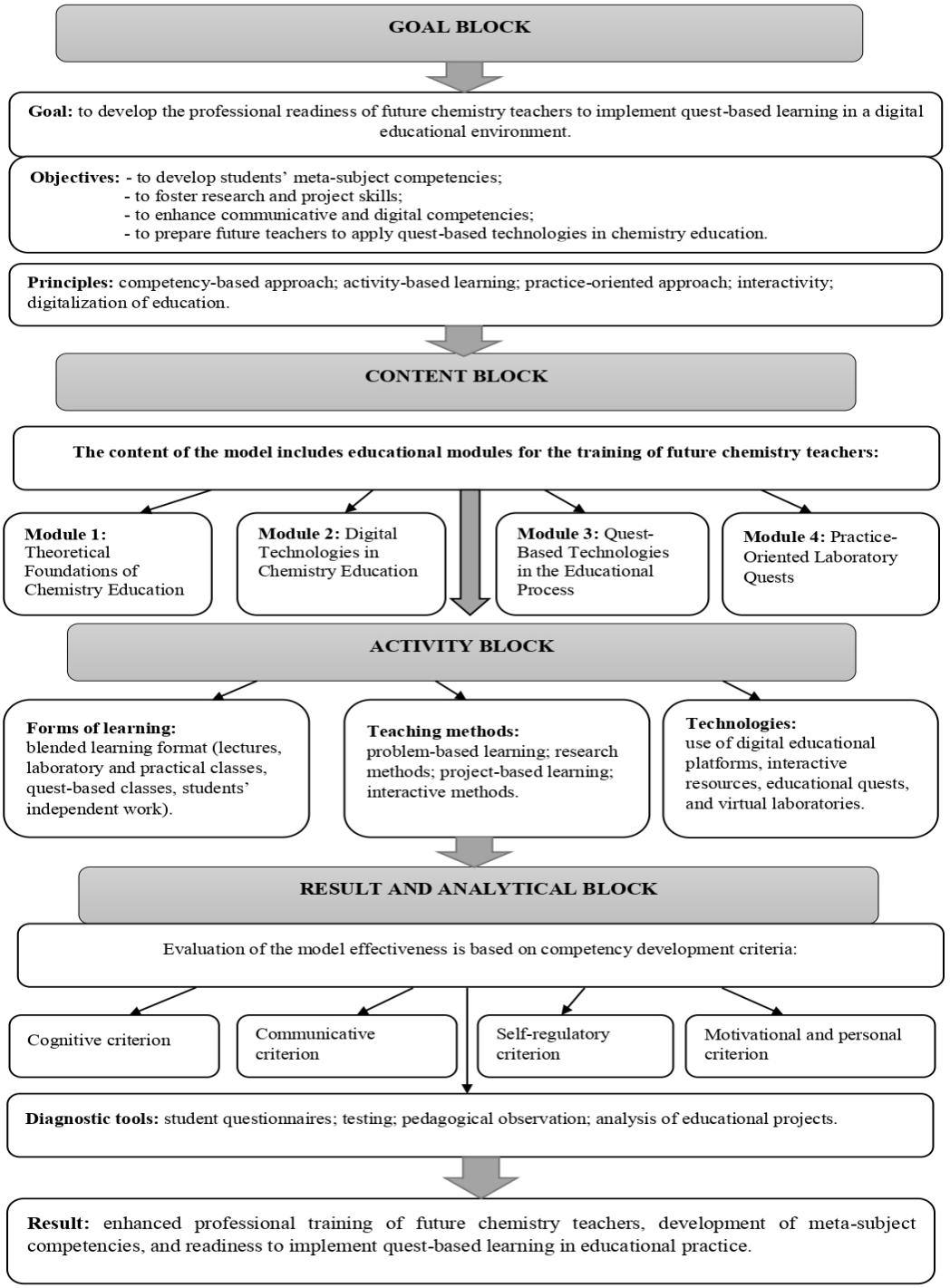

Figure 1 - An innovative structural–functional model of professional training of future chemistry teachers based on quest-based learning

The proposed model envisions a phased integration of quest technologies into the educational process: from a theoretical introduction to their fundamentals to students designing and implementing quests themselves. Key to this is creating conditions that foster sustainable motivation, interest in learning, and supporting a digital infrastructure that ensures the effective implementation of quests [3, 8].

The scientific literature presents various interpretations of the concept of quest technology. For example, I.V. Kuznetsova considers it a form of active learning, emphasizing its pedagogical effectiveness and potential for enhancing students' cognitive activity [2]. A.A. Ivanova and N.S. Petrova focus on the methodological features of using quests in chemistry education, highlighting the various forms of their implementation [3]. E.Yu. Smirnova reveals the connection between the competency-based approach and activity-based technologies, including quests, pointing to their role in the development of key professional skills [6].

T.V. Vorobyova notes the importance of organizational and pedagogical conditions necessary for the effective implementation of educational quests [9]. American Researcher J.P. Gee substantiates the use of game mechanisms as the basis for engaging learning [1], and German scientist Deterding, S. highlights elements of gamification, actively used in quest approaches [10]. Mayer, R. E. in his works scientifically proves the effectiveness of multimedia technologies in enhancing the cognitive impact of quests on students [7].

Thus, the conducted analysis of the works of domestic and international researchers allows us to systematize the advantages and identify the forms of implementation of quest technologies in the training of future chemistry teachers. These data are summarized and presented in Tables 1 and 2.

Table 1. Advantages of quest technologies in the training of chemistry teachers

Advantage	Description
Activation cognitive activities	student motivation and engagement in the learning process
Formation critical thinking	Promotes the development of analytical and creative skills
Development communicative competencies	Encourage teamwork, collaboration and knowledge sharing
Integration digital technologies	Using online platforms and resources improves digital literacy
Applied character training	Applying knowledge in practice through solving real and simulated problems
Formation professional skills	Developing skills in designing and delivering educational events

Table 2. Forms of implementation of quest technologies in the training of chemistry teachers

Form quest	Characteristic
Training quest	A series of assignments on specific topics in chemistry, aimed at mastering theoretical and practical aspects

Methodical quest	Development and testing of educational activities or teaching materials with quest elements
Digital (web) quest	Using interactive platforms and resources to organize the online learning process
Interdisciplinary quest	Integration of chemistry with other subjects (biology, ecology) for comprehensive problem solving
Author's quest	create a quest to consolidate and demonstrate acquired knowledge and skills

An analysis of the data presented in Tables 1 and 2 allows us to conclude that quest technologies have a multifaceted pedagogical potential. Their advantages extend not only to increased student motivation but also to the development of critical thinking, communication skills, and the ability to independently design educational activities. The variety of quest implementation formats demonstrates the flexibility of this technology and its adaptability to various disciplines and levels of training. This confirms the feasibility of integrating the quest approach into the professional training model for future chemistry teachers as a system-forming element.

As part of the study, aimed at identifying the specifics of integrating quest technologies into the professional training system for teachers, a comparative analysis of domestic and international experience in their application was carried out. allowed define Both general trends and differences in approaches to the design, organization, and implementation of quests in teacher education are analyzed. The results of the comparative analysis are presented in Table 3.

Table 3. Comparison of foreign and domestic approaches to the use of quest technologies in teacher training

Criterion	Foreign approach	Approach CIS countries
Methodology	Gamification, problem-based learning (PBL), and constructivism are actively used [1, 10]	The main emphasis is on activity-based and competence-based approaches [3, 6]
Goals training	Development of software skills, individualized learning, interdisciplinarity	Formation of professional and pedagogical competencies
Tools and platforms	Use of specialized digital platforms (Moodle, Quest Garden, Classcraft)	Using traditional and digital tools (PowerPoint, Google Forms, Zoom, Padlet)
Role teacher	Facilitator, moderator process, mentor	Organizer of the educational process, developer of methodological materials
Forms quests	Web quests, game simulations, mobile applications	Educational and methodological quests, digital web resources
Grade results	Use of digital monitoring systems, reflection and self-assessment	Combination of traditional and innovative assessment methods

The differences presented in Table 3 indicate that the level of institutional and technological support significantly influences the depth of integration of quest

technologies into the educational process. In international models, quests act as a systemic element of the educational program, integrated into competency-based trajectories and supported by digital infrastructure. In domestic practice, quests are more often implemented as an additional, innovative form, which limits their potential for developing sustainable professional competencies.

These differences confirm the need to develop a structured model for implementing quest technologies that can ensure their systematic integration into the training of future chemistry teachers, taking into account the national educational context.The main objective of this study was to identify the methodological, organizational, pedagogical and technological features of the implementation of quest technologies, as well as to determine the possibilities of adapting the most effective foreign practices to the conditions of the Kazakhstani and, more broadly, the CIS model of training future chemistry teachers.

The conducted analysis allowed us to identify the following features of the application of quest technologies in domestic and international practice:

International approaches are characterized by a higher level of systemic integration of quest technologies into educational programs. In these models, quests are an integral part of project-based and inquiry-based learning, incorporated into competency-based learning pathways, and actively integrated with modern digital tools such as augmented reality platforms, virtual simulators, and interactive educational environments.

In the CIS countries (particularly Kazakhstan and Russia), quests are more often used as an innovative but complementary form of learning, not integrated into core academic disciplines. They are used primarily within elective courses, methodological seminars, or extracurricular activities.

The methodological differences lie in the fact that in the domestic pedagogical tradition, activity-based and personality-oriented approaches prevail, while foreign researchers more often rely on constructivist and gamification models, in which the quest is viewed as a means of organizing active, interactive and meaningful learning.

Technological and infrastructural differences are also significant. Domestic teachers primarily use tools like Google Forms, Moodle, and PowerPoint, while international specialists rely on specialized digital platforms such as Quest Garden and Unity, as well as AR/VR - based solutions. This significantly expands the possibilities for individualized learning and increases student engagement [10].

Thus, the comparative analysis confirms the high potential of quest technologies as an effective tool for developing the meta-subject and professional competencies of future teachers. The study's results highlight the need to develop national methodological approaches that draw on both domestic pedagogical experience and the adaptation of successful international practices.

Discussion

To ensure the successful implementation of quest technologies in the system of professional training of future chemistry teachers, it is important to consider the set of factors that determine the integrity and effectiveness of

the educational process. relate Psychological, pedagogical, methodological, technical, organizational, managerial, and substantive conditions. Each of these aspects plays a significant role in developing students' professional competencies, increasing their academic motivation, and developing cognitive activity.

To ensure the successful implementation of quest technologies in the professional training of future chemistry teachers, it is important to consider the complex factors that determine the integrity and effectiveness of the educational process. These include psychological, pedagogical, methodological, technical, organizational, managerial, and substantive conditions. Each of these aspects plays a significant role in developing students' professional competencies, increasing their learning motivation, and developing cognitive activity.

A detailed description and characteristics of these conditions are presented in Table 4.

Table 4. Conditions for the implementation of quest technologies in the professional training of future chemistry teachers

Condition	Description
Methodological Preparation	Training teachers in creating and maintaining quests, advanced training
Technical equipment	Access to modern digital platforms, equipment and internet resources
Motivation students	Formation of internal interest through the significance and practical focus of tasks
Integration into the curriculum plan	Inclusion of quests in the structure of academic disciplines and educational programs
Support administration	Creating conditions and allocating time for the development and implementation of quests
Assessment and reflection	Implementation of feedback systems and analysis of the effectiveness of educational quests

An analysis of the presented conditions shows that the successful implementation of quest technologies is determined not only by their methodological content but also by a combination of organizational and infrastructural factors. These conditions, taken together, ensure the functioning of the developed model as a holistic pedagogical system and create a foundation for the sustainable development of professional and meta-subject competencies in future chemistry teachers. Table 4 thus specifies the mechanism for the practical implementation of the proposed model and confirms its systemic nature.

The developed model received theoretical and methodological justification, which allowed us to move on to the stage of its experimental testing in a real-world educational setting. To test the effectiveness of the structural and functional model, a pedagogical experiment was conducted, the results of which are presented below.

Table 5 – Dynamics of average indicators of meta-subject competencies

Group	*Before the experiment*	*After the experiment*	*Increase*
Experimental	3,13	4,45	+1,32
Control	2,38	3,07	+0,69

A comparative analysis of average scores revealed a more pronounced positive trend in the experimental group, where training was conducted using quest technologies. The average score increased from 3.13 to 4.45 (an increase of 1.32), while in the control group, the increase was 0.69 points (from 2.38 to 3.07). These data demonstrate the higher effectiveness of the developed professional training model based on quest technologies.

The trend in average scores is shown in Figure 2.

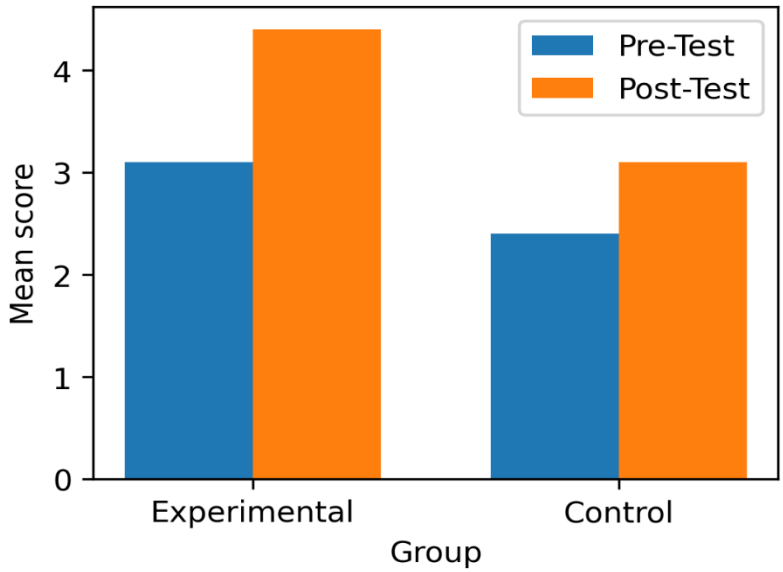

Figure 2 - Trend in average scores for meta-subject competencies in the experimental and control groups

The results obtained allow us to conclude that the developed innovative model for the professional training of future chemistry teachers possesses significant pedagogical potential. The significantly greater increase in performance in the experimental group suggests that the inclusion of quest-based learning in the training structure has a comprehensive impact on the development of meta-subject competencies. Unlike traditional teaching, the quest-based approach facilitates the integration of students' cognitive, communicative, and reflective activities, which facilitates deeper learning and the development of professional readiness. This focus of training aligns with the findings of Nurbayeva [11], who emphasizes the importance of value orientations and personal motivation in the professional development of students majoring in pedagogy.

An analysis of the model's structure suggests that the activity-based and performance-based analytical components contributed most to the achieved effect. Students' active participation in the design and implementation of quests created conditions for the application of knowledge in a practical context, the development of teamwork skills, and the formation of sustainable motivation for professional work. Systematic feedback provided the opportunity for reflective adjustments to the goals and content of training, thereby enhancing the manageability of the educational process.

These findings are consistent with the findings of international researchers [1], [7], who emphasize the role of gaming and multimedia mechanisms in increasing students' cognitive engagement, as well as with the work of Russian authors [3], [6], who consider quest technologies as an effective tool for implementing a competency-based approach. However, unlike existing studies, where quests are more often considered a separate method of active learning, in this paper they are presented as a system-forming element of the structural and functional model of professional training.

Thus, the experimental testing confirms the feasibility of integrating quest-based learning into the training of future chemistry teachers at the level of the educational model, and not just at the level of individual teaching methods. However, it should be noted that the study was conducted on a limited sample and over the course of a single semester, which may affect the generalizability of the results. A larger sample, longer-term longitudinal observations, and the use of more detailed statistical methods for data analysis appear promising areas for further research.

Conclusion

The study allowed us to develop and theoretically substantiate an innovative structural and functional model for the professional training of future chemistry teachers based on quest-based learning. This model includes motivational-targeted, content-based, activity-based, and performance-analytical components, all integrated by a systemic feedback mechanism. Unlike existing approaches, which view quests primarily as a standalone active learning method, in the presented model, they serve as a system-forming element integrating content, activities, and assessment of training results.

Experimental testing of the model confirmed its effectiveness: the experimental group demonstrated a more pronounced positive trend in the development of meta-subject competencies compared to the control group, demonstrating the effectiveness of the systemic integration of quest technologies into the educational process.

A comparative analysis of domestic and international experience revealed differences in the level of institutional integration of quest technologies, methodological foundations, and digital support for educational programs. International practice demonstrates a more systematic implementation of quests, whereas in the CIS countries, they are primarily used as an additional form of learning, which limits their potential.

It has been established that the success of quest-based learning is determined by a combination of methodological, technical, and organizational-pedagogical conditions that ensure the integrity, manageability, and sustainability of the educational process.

The practical significance of the study lies in the potential use of the developed model in modernizing training programs for future chemistry teachers in the context of the digital transformation of higher education.

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КВЕСТ-ОҚЫТУ НЕГІЗІНДЕ БОЛАШАҚ ПЕДАГОГ-ХИМИКТЕРДІ КӘСІБИ ДАЯРЛАУДЫҢ ИННОВАЦИЯЛЫҚ МОДЕЛІ

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Аңдатпа. Мақалада белсенді оқытудың инновациялық және тиімді құралы ретінде квест технологияларын қолдана отырып, болашақ химия мұғалімдерін кәсіби даярлау процесін жан-жақты талдау және модельдеу ұсынылған. Білім беруді жедел цифрландыру және педагогикалық білім беру мазмұнын жаңарту жағдайында квест-оқыту қазіргі заманғы оқыту әдістемесінің маңызды элементіне айналатыны атап өтілді. Квест-технологиялардың теориялық және әдіснамалық негіздері, олардың мәні, құрылымы және құзыреттілік тәсіл контекстіндегі педагогикалық әлеуеті қарастырылады. Болашақ педагогтардың кәсіби, зерттеу және мета-пәндік құзыреттіліктерін кешенді қалыптастыруды қамтамасыз ететін білім беру процесіне квесттерді сәтті енгізудің негізгі компоненттерін, кезеңдері мен педагогикалық шарттарын қамтитын құрылымдық-функционалдық модель әзірленді.

Педагогикалық білім беру саласындағы квест-технологияларды дамытудың жалпы тенденциялары мен бағыттарын анықтауға мүмкіндік беретін отандық және шетелдік зерттеулерге салыстырмалы талдау жүргізілді. Квесттердің дидактикалық мүмкіндіктеріне, олардың студенттердің мотивациясын арттырудағы, сыни және креативті ойлауды, командалық өзара әрекеттесу және өзіндік жұмыс дағдыларын қалыптастырудағы рөліне ерекше назар аударылады. Квест оқытудың интегративті түрі ретінде студенттердің білім беру процесіне белсенді қатысуына жағдай жасай отырып, ойын, зерттеу, ақпараттық және проблемалық-бағдарланған әдістерді біріктіретіні атап өтілді.

Мақалада химия мұғалімдерін даярлаудағы квесттерді жүзеге асыру нысандары, оның ішінде оқу, зерттеу және цифрлық квесттер, сондай-ақ оларды білім беру ортасына тиімді интеграциялаудың ұйымдастырушылық-техникалық және әдістемелік шарттары егжей-тегжейлі сипатталған. Квест-технологиялар болашақ педагогтардың кәсіби даярлығының сапасын арттыруға, олардың шығармашылық әлеуетін, коммуникативтік дағдыларын дамытуға және қазіргі білім беру жағдайында кәсіби қызметке тұрақты уәждеме жасауға ықпал етеді деген қорытындыға келді.

Тірек сөздер: квест-технологиялар, кәсіптік даярлау, модельдеу, химия мұғалімі, интерактивті оқыту, білім беруді цифрландыру, педагогикалық инновациялар, құзыреттілік тәсіл

ИННОВАЦИОННАЯ МОДЕЛЬ ПРОФЕССИОНАЛЬНОЙ ПОДГОТОВКИ БУДУЩИХ ПЕДАГОГОВ-ХИМИКОВ НА ОСНОВЕ КВЕСТ-ОБУЧЕНИЯ

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Аннотация. В статье представлен развернутый анализ и моделирование процесса профессиональной подготовки будущих учителей химии с использованием квест-технологий как инновационного и эффективного инструмента активного обучения. Подчёркивается, что в условиях стремительной цифровизации образования и обновления содержания педагогического образования квест-обучение становится значимым элементом современной методики преподавания. Рассматриваются теоретико-методологические основы квест-технологий, их сущность, структура и педагогический потенциал в контексте компетентностного подхода. Разработана структурно-функциональная модель, включающая основные компоненты, этапы и педагогические условия успешного внедрения квестов в образовательный процесс, обеспечивающая комплексное формирование профессиональных, исследовательских и метапредметных компетенций будущих педагогов.

Проведён сравнительный анализ отечественных и зарубежных исследований, позволивший выявить общие тенденции и направления развития квест-технологий в сфере педагогического образования. Особое внимание уделено дидактическим возможностям квестов, их роли в повышении мотивации студентов, формировании критического и креативного мышления, умений командного взаимодействия и самостоятельной работы. Отмечено, что квест, как интегративная форма обучения, объединяет игровые, исследовательские, информационные и проблемно-ориентированные методы, создавая условия для активного участия студентов в образовательном процессе.

В статье подробно описаны формы реализации квестов в подготовке учителей химии, включая учебные, исследовательские и цифровые квесты, а также организационно-технические и методические условия их эффективной интеграции в образовательную среду. Сделан вывод о том, что квест-технологии способствуют повышению качества профессиональной подготовки будущих педагогов, развитию их творческого потенциала, коммуникативных навыков и устойчивой мотивации к профессиональной деятельности в условиях современного образования.

Ключевые слова: квест-технологии, профессиональная подготовка, моделирование, учитель химии, интерактивное обучение, цифровизация образования, педагогические инновации, компетентностный подход

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