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REVIEW OF THE IMPLEMENTATION OF THE ALLIANCE "SCHOOL – UNIVERSITY – SCIENCE – INDUSTRY" IN THE HOLISTIC PEDAGOGICAL PROCESS

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Abstract. The article addresses the urgent issue of developing the system of secondary and higher education in the Republic of Kazakhstan in the context of implementing the Education Development Concept for 2022–2026. Based on a theoretical analysis of regulatory and legal documents, scholarly pedagogical literature, as well as data obtained from interviews and questionnaires, systemic gaps in the training of teaching staff–primarily teachers of natural science disciplines–have been identified. It has been established that the predominance of subject-centered and fact-based approaches to teaching, insufficient flexibility of the educational system, and weak integration of education, science, and industry have a negative impact on the formation of students' motivation for conscious career choice and participation in project-based and research activities. The study shows that a significant proportion of teachers are not prepared to organize and provide scientific guidance for students' research activities, which contradicts contemporary requirements for educational quality and the objectives of training competitive specialists. The scientific novelty of the research lies in substantiating the need to form a sustainable alliance model "School – University – Science – Industry" as a tool for enhancing the educational and research potential of teaching staff and students of pedagogical universities. The article proposes directions for improving the regulatory framework, educational programs, and mechanisms for

teacher retraining, and also justifies the feasibility of establishing a pedagogical technology park as an environment for integrating educational, scientific, and industrial components. The research findings may be used in the modernization of educational programs of pedagogical universities and in the development of practice-oriented models for training teaching personnel. The value of the study lies in a systematic analysis of the current situation and the development of effective pathways for enhancing the research capacity of teaching staff in the field of natural sciences.

Keywords: University, school, industry, alliance, teacher, preparation, innovation, project and research activities

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ТҰТАС ПЕДАГОГИКАЛЫҚ ҮДЕРІСТЕ "МЕКТЕП – ЖОҒАРЫ ОҚУ ОРНЫ –ҒЫЛЫМ-ӨНДІРІС" АЛЬЯНСЫН ЕНГІЗУДІ ЗЕРТТЕУ БОЙЫНША ШОЛУ

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Аннотация. Мақалада 2022-2026 жылдарға арналған білім беруді дамыту тұжырымдамасын іске асыру жағдайында Қазақстан Республикасының орта және жоғары білім беру жүйесін дамытудың өзекті мәселесі қарастырылады. Нормативтік-құқықтық құжаттарды, ғылыми-педагогикалық әдебиеттерді, сондай-ақ сұхбат пен сауалнама деректерін теориялық талдау негізінде педагог кадрларды, ең алдымен жаратылыстану-ғылыми бағыттағы мұғалімдерді даярлаудағы жүйелі олқылықтар анықталды. Оқытудағы пәндік-бағдарланған және нақты тәсілдердің басым болуы, білім беру жүйесінің икемділігінің жеткіліксіздігі және білім беру, ғылым мен өндірістің әлсіз интеграциясы оқушылардың саналы кәсіби таңдауға және жобалау-зерттеу қызметіне қатысуға деген ынтасын қалыптастыруға теріс әсер ететіні анықталды. Педагогтердің

едәуір бөлігі білім алушылардың зерттеу жұмыстарын ұйымдастыруға және ғылыми сүйемелдеуге дайын емес екендігі көрсетілген, бұл білім сапасына қойылатын заманауи талаптарға және бәсекеге қабілетті мамандарды даярлау міндеттеріне қайшы келеді. Зерттеудің ғылыми жаңалығы педагогикалық кадрлар мен педагогикалық ЖОО студенттерінің ғылыми-зерттеу әлеуетін жетілдіру және арттыру құралы ретінде "Мектеп-ЖОО-ғылым-өндіріс" Альянсының тұрақты моделін қалыптастыру қажеттілігін негіздеу болып табылады. Мақалада мұғалімдерді қайта даярлаудың нормативтік базасын, білім беру бағдарламалары мен тетіктерін жетілдіру бағыттары ұсынылған, сондай-ақ білім беру, ғылыми және өндірістік компоненттерді интеграциялау ортасы ретінде педагогикалық технопарк құрудың орындылығы негізделген. Зерттеу нәтижелері педагогикалық жоғары оқу орындарының білім беру бағдарламаларын жаңғырту және педагогикалық кадрларды даярлаудың тәжірибеге бағытталған модельдерін әзірлеу кезінде пайдаланылуы мүмкін. Жүргізілген зерттеудің құндылығы ағымдағы жағдайды жүйелі талдау және жаратылыстану ғылымдары саласындағы педагог кадрлардың ғылыми әлеуетін жақсартудың тиімді жолдарын әзірлеу болып табылады.

Түйін сөздер: ЖОО, мектеп, өндіріс, альянс, мұғалім, дайындық, инновация, жобалау және зерттеу қызметі

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ОБЗОР ПО ИССЛЕДОВАНИЮ ВНЕДРЕНИЯ АЛЬЯНСА «ШКОЛА – ВУЗ – НАУКА – ПРОИЗВОДСТВО» В ЦЕЛОСТНОМ ПЕДАГОГИЧЕСКОМ ПРОЦЕССЕ

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Аннотация. В статье рассматривается актуальная проблема развития системы среднего и высшего образования Республики Казахстан в условиях реализации Концепции развития образования на 2022-2026 годы. На основе теоретического анализа нормативно-правовых документов, научно-педагогической литературы, а также данных интервьюирования и анкетирования выявлены системные пробелы в подготовке педагогических кадров, прежде всего учителей естественно-научного направления.

Установлено, что преобладание предметно-ориентированного и фактического подходов в обучении, недостаточная гибкость образовательной системы и слабая интеграция образования, науки и производства негативно сказывается на формирование у школьников мотивации к осознанному профессиональному выбору и участию в проектно-исследовательской деятельности. Показано, что значительная часть педагогов не готова к организации и научному сопровождению исследовательской работы обучающихся, что противоречит современным требованиям к качеству образования и задачам подготовки конкурентоспособных специалистов. Научная новизна исследования заключается в обосновании необходимости формирования устойчивой модели альянса «Школа - Вуз - Наука – Производство» как инструмента повышения и научно-исследовательского потенциала педагогических кадров и студентов педагогических вузов. В статье предложены направления совершенствование нормативной базы, образовательных программ и механизмов переподготовки учителей, а также обоснована целесообразность создания педагогического технопарка как среды интеграции образовательного, научного и производственного компонентов. Результаты исследования могут быть использованы при модернизации образовательных программ педагогических вузов и разработке практико-ориентированных моделей подготовки педагогических кадров. Ценностью проведенного исследования является систематический анализ текущей ситуации и разработка эффективных путей улучшения научного потенциала педагогических кадров в области естественных наук.

Ключевые слова: Вуз, школа, производство, альянс, учитель, подготовка, инновация, проектная и исследовательская деятельность

Introduction. Innovation arises as a result of attempts to solve familiar problems by other methods, in the course of a long process of accumulating and analyzing data, which leads to the emergence of a new quality with innovative meaning. Innovations today are applied to all areas of human activity. However, considering the stages of formation of a "trained specialist", and this is a school, university, industry, one thinks about the primacy of the application of innovative ideas. For example, an already trained specialist should come to production, which means that it is necessary to train him at the university, but a student should come to the university with a clear idea of what he is interested in, who he wants to become, etc.

The concept of innovation today includes the possibility of developing and implementing "new" through project or research activities. So, in order to "see" the idea, it is necessary to prepare a person, which means that it is necessary to start from school. In order to prepare schoolchildren for choosing a profession, for conducting project and research activities, it is also necessary to prepare it. Therefore, the link between school and production is the "university". In our case, we mean the training of teachers and the natural sciences. The relationship between the system "school-university-science-Industry" immediately becomes clear. The

result of innovative processes ***in education*** is the introduction of both theoretical and practical innovations, as well as innovations that arise at the intersection of ***theory and practice*** E.C., Miller, J.S. Krajcik (Miller and Krajcik, 2019), A.V. Gam (Gam, 2020), L.V. Kozhemyakina (Kozhemyakina, 2022), E.S. Polat (Polat, 2020), T.A. Popova (Popova, 2020), I.A. Pogrebnaya, S.F. Semenikhina (Pogrebnaya and Semenikhina, 2022).

Let's take a closer look at the need to define the topic, develop and implement our research.

Innovation in education:

The modern transformation of the education system has affected the training of teachers. The requirements for pedagogical universities of the country in the field of training scientific potential, namely the documents regulating the activities of teachers, determine the priority areas of the goals and content of school education.

Today, many requirements are also imposed on a schoolchild: he must become enterprising with developed critical thinking, literate, independent and highly moral. In order to form all the indicated qualities in schoolchildren, it is necessary to train ***teaching staff***. Only a trained teacher will be able to achieve the goal of teaching and forming all the qualities of schoolchildren.

Thus, the new vision of higher education in the training of school teachers allows us to assert that today ***it*** will not be enough to teach (in the field of KSA), and an important point is given to the formation of competencies with a modern vision, as well as the definition of non-standard, active, creative (including project and research) abilities of students. In turn, the transformations have also affected the content of the training of teachers for activities in the living conditions of the school, the social life of society and the economic realities of the country. To increase the scientific potential, the quality of educational programs implemented in pedagogical universities is important.

The introduction of new forms of organization of scientific activities of the younger generation is implemented on the basis of the formation of the continuity of the pedagogical system of the design and research type, in the context of the integration of the educational process into a certain (as mentioned above) alliance "School - University - Science - Production".

To date, the problem of teaching staff is that they themselves are not prepared to conduct scientific activities. Requests of the State Institution "Department of Education of the city of Aktobe" and the Department of Education of the Aktobe region for participation in scientific competitions are increasingly in demand by subject teachers and schoolchildren. But, as the practice of reviewing these projects shows, a school teacher cannot deal with the topic of a scientific project, correctly formulate the topic, prepare the scientific apparatus, do not know the main stages of research, cannot determine the methodology and methods, etc. This completely contradicts the concept of education development in Kazakhstan until 2025 (Strategy "Kazakhstan-2050" …, 2012; The state mandatory standard …, 2018). And our task is to train a competitive specialist who is able to qualitatively prepare

and educate a student within the framework of the "School - University - Science - Production" alliance.

An innovation in the education system should be the research potential in education, which demonstrates the latest and consistent chain between the state of the level of education and the economic potential of the country.

Our study acquires scientific novelty on the basis of a thorough analysis of the regulatory documents of the Republic of Kazakhstan, which provide guidelines for solving urgent problems in the education system E.S. Polat (Polat, 2020). The existing methodological base, structure and content of the Kazakh education system leave much to be desired, not meeting the modern requirements of the world educational space G.Zh. Tayauova, G.Zh. Alibekova, Zh.B. Ilmaliev, O.B. Kenzhaliev (Tayauova et al., 2018).

Literary review. Let's consider the conceptual foundations of the integration of education, science and industry. In the context of global socio-economic transformations and the transition to a knowledge economy, the need to integrate various levels and spheres of education with science and Industry is becoming urgent. Scientific research in recent decades has emphasized that the fragmentation of educational institutions reduces the quality of staff training and prevents students from forming a holistic view of their future professional activities E.S. Polat (Polat, 2020).

The idea of the «School –University – Science– Industry» alliance is based on systematic and activity-based approaches that consider education as a continuous, holistic process aimed at the development of personality, its professional and scientific potential.

In foreign pedagogy and educational policy, the concept of Triple Helix and Quadruple Helix is widely used, suggesting the interaction of universities, science, business and society, which was substantiated by researchers L. Leydesdorff (Leydesdorff, 2010), Y. B. Xue, O. B. Keat (Xue and Keat, 2025), developed an innovative model of the triple helix relationship between university, industry and government for empirical research and explanation of structural relationships. These models are considered as the basis for innovative development and training of competitive specialists based on knowledge production.

In domestic and post-Soviet studies I.A. Zimnaya (Zimnaya, 2006), A.K. Kusainov (Kusainov, 2013), E.S. Polat (Polat, 2020), educational alliances are analyzed from the perspective of:

– continuity of education levels;

– practice-oriented learning;

– development of students' research and project activities (Polat, 2020).

It is noted that in this model, the school acts not only as a basic level of education, but also as a space for early career guidance and the formation of a research culture, and the university as a center for scientific, methodological and personnel support.

The researchers point out that a modern school should move from a translational learning model to a model focused on the development of universal learning activities, research skills and value orientations.

In the works devoted to school science education, it is emphasized that the integration of schools with universities and scientific organizations:

– increases students' motivation to study natural sciences;

– promotes informed professional choice;

– forms students' understanding of scientific and engineering activities.

However, a number of authors note the insufficient readiness of schools for such interaction, due to a shortage of human, methodological, and logistical resources.

A special place in the literature is occupied by the problem of training pedagogical personnel capable of working in conditions of integration of education, science and industry. According to the researchers, M.V. Melnichuk, Yu.M. Gruzina, I.A. Firsova (Melnichuk et al., 2019) the traditional subject-oriented model of teacher training does not ensure the formation of their research and project competencies.

In the works of Kazakhstani scientists G.Zh. Tayauova, G.Zh. Alibekova, Zh.B. Ilmaliev, O.B. Kenzhaliev (Tayauova et al., 2018), A.K. Kusainov, S.T. Shaikhislamov, G.K. Nurgalieva (Kusainov et al., 2019), O.B. Kenzhaliyev, Z.B. Ilmaliyev, A.F. Tsekhovoy, M.B. Triyono, G.K. Kassymova, G.Z. Alibekova, and G.Z. Tayauova (Kenzhaliyev et al., 2021), it is noted that a significant part of teachers experience difficulties in:

– organizing students' design and research activities;

– cooperation with universities and scientific institutions;

– the introduction of practice-oriented forms of education.

In this regard, the necessity of creating innovative forms of teacher training, including pedagogical technology parks, internships at universities and manufacturing enterprises, is justified.

The analysis of scientific publications shows that the participation of scientific organizations and industrial enterprises in the educational process contributes to:

– updating the content of education;

– development of applied and research skills;

– formation of professional and supra-professional competencies.

The production environment is considered as an important resource for the implementation of project-based learning, dual education and mentoring. At the same time, it is emphasized that the lack of regulatory mechanisms for interaction reduces the effectiveness of such forms of cooperation.

Despite the recognition of the importance of the "School – University – Science – Industry" alliance, a number of systemic problems are highlighted in the literature:

– fragmentation of interaction between the members of the alliance;

– insufficient regulatory and legal regulation;

– the gap between theoretical training and practical requirements of production;

– a low level of research culture among some teachers and students.

These contradictions point to the need to develop a holistic model of the pedagogical alliance, integrated into the educational system at the institutional level.

The analysis of scientific sources shows that the introduction of the "School –

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University – Science – Industry" alliance is considered by modern researchers as a promising direction for the modernization of education. At the same time, the following have not been sufficiently developed:

– pedagogical mechanisms for the implementation of the alliance in the holistic pedagogical process;

– models of scientific support for school research activities;

conditions for increasing the scientific and research potential of teaching staff.

A bibliometric analysis of research on cooperation between universities and industry in post-Soviet countries conducted by K. Moldashev, S. Kozhahmet, A. Yenikeeva, A. Nurgabdeshov (Moldashev et al, 2019), K. Moldashev, A. Nurgabdeshov and S. Kozhakhmet (Moldashev et al, 2026) identifies challenges: state dominance, weak industrial demand and cultural barriers, but notes opportunities in program reform and dual education, employment-oriented learning models.

These provisions determine the relevance of this research and substantiate the need to develop a systematic model of an educational alliance focused on the integration of learning, education, science and practice.

Materials and methods. The research is based on a systematic, competence-based approach. The materials used are regulatory and legal documents of the Republic of Kazakhstan in the field of secondary and higher education, scientific and pedagogical literature, as well as statistical and analytical data from authorized bodies.

In the course of the work, theoretical methods of analysis and generalization of scientific sources and normative documents, the comparative analytical method, as well as empirical methods were used: questionnaires, interviews and expert assessment of teachers and students of pedagogical educational programs. A modeling method was used to develop a theoretical model.

This combined approach has made it possible to comprehensively assess the state and prospects of education development in the country.

Results. Our theoretical analysis of the legislation of the Republic of Kazakhstan, and the theoretical analysis of scientific and pedagogical literature on this research issue, allowed us to identify certain and quite significant gaps both in the secondary education system (training schoolchildren and the training of teaching staff) and in the higher education system in the training of future teaching staff (in our case, future teachers of natural sciences) through interviews, surveys, etc. The main reasons for the existing problems identified in our study were: insufficient flexibility of the education system and its inability to innovate; lack of motivation to implement a quality assurance system; weak motivation to achieve a high level of education in the training process. Thus, we propose an innovative approach to improving the educational environment, taking into account the identified problems and focused on activating the scientific potential of teaching staff and students.

In the current situation, the main tasks should be:

1. Improvement of the Legislative and Regulatory Framework:

- Further democratization and public participation in education management.
- Ensuring the effective functioning of the Kazakh education model through the improvement of the legislative and regulatory framework.

2. Integration of Education, Science and Industry:
- Development of mechanisms for 4-way integration.
- Support for the real sector of the economy to improve educational quality.

3. Introducing innovations through design and research activities:
- Support for the possibility of developing and implementing "new" through design or research activities.
- Creating conditions for students to develop project and research skills.

4. Natural science teacher training:
- Solving the problem of teaching staff who are not ready for scientific activity.
- Preparation of teachers for the formulation of research topics, preparation of scientific apparatus, definition of methodology and research methods.

5. The relationship between School, University, Science and Industry:
- Establishing a close relationship between school, university, science and industry.
- Development of measures aimed at improving interaction and exchange of experience within the framework of the School - University - Science- Industry alliance.

6. Creation of Competitive Specialists:
- Compliance of teacher and student training according to the Concept of Education development in Kazakhstan.
- Training of competitive specialists capable of leading the country in the future.

We proceed from the premise that the successful implementation of the program of the alliance "School - University - Science - Industry" in the context of project and research activities aimed at training future teachers of natural sciences, as well as the creation of a Pedagogical Technopark (in our case, the Pedagogical Technopark named after A. A. Kalyuzhny on the basis of Aktobe Regional University named after K. Zhubanov, established in memory of Professor Anatoly Afanasyevich Kalyuzhny, Doctor of Pedagogy and Doctor of Psychology), will ensure the sustainable and effective integration of all participants in this alliance, contributing to the formation of a holistic and continuous pedagogical environment. Thus, the identified gaps in the system of secondary and higher education and, based on this, the tasks set allow us to determine the solution of further scientific issues, which (in our opinion) include the following aspects:

1. Identification of the possibilities of teaching staff in the natural sciences in the context of the alliance "School - University - Science - Industry":
- Conducting a search for the available resources and potential of teaching staff within the framework of this alliance.
- Analysis of the identified opportunities in order to identify shortcomings in project and research activities, and teacher training for scientific competitions.

2. Development of effective methods of retraining teaching staff at the university level:

- Search for possible ways and mechanisms for retraining teaching staff with an emphasis on strengthening their scientific potential.

- Analysis of the effectiveness of the proposed methods in order to eliminate the identified gaps in the scientific potential of teaching staff.

- Revision of educational programs for teacher training, taking into account the requirements of the state program for the training of teachers and the relevant research objectives.

Discussion. The theoretical analysis of the legislation of the Republic of Kazakhstan, as well as the analysis of scientific and pedagogical literature on the research problem in conjunction with empirical methods (interviews, questionnaires, surveys of teachers and students) made it possible to identify a number of systemic and stable gaps characteristic of both the system of secondary education and the system of higher pedagogical education. Within the framework of this study, special attention was paid to the training of future teachers of the natural sciences, which is due to the increasing role of natural science knowledge in the context of scientific and technological development and digitalization of society.

The results obtained indicate that in the system of secondary education there is an insufficient level of readiness of schoolchildren for project and research activities, a weak orientation to scientific knowledge and conscious professional choice. This is largely due to the limited training of teaching staff to organize the research work of students, as well as the lack of sustainable motivation to implement innovative educational practices. Similar problems have been identified in the system of higher education, where the training of future teachers is often mainly theoretical in nature and is not fully focused on the formation of research, project and innovative competencies.

An analysis of the causes of the existing problems made it possible to identify several key factors. First, the education system as a whole is characterized by insufficient flexibility and low adaptability to the introduction of innovations. Despite the presence of regulatory documents and strategic programs, the real implementation of innovative approaches in educational practice is fragmentary and not systematic. Secondly, insufficient motivation of teaching staff and educational organizations to implement a system for ensuring the quality of education based on scientific research, project activities and analysis of educational results was revealed. Thirdly, there is a weak motivation of students and future teachers to achieve a high level of education, which is manifested in a formal attitude to scientific activity and limited participation in research and innovation projects.

In the context of the identified problems, we propose an innovative approach to improving the educational environment, focused on activating the scientific potential of teaching staff and students. This approach is based on the idea of system integration of education, science and Industry, which corresponds to modern world trends in the development of educational systems and strategic priorities of the Republic of Kazakhstan.

In the current situation, the key tasks for the development of the educational

system should be, first of all, the improvement of the legislative and regulatory framework. Further democratization of education management and expansion of public participation in managerial decision-making can increase the transparency and efficiency of the functioning of the Kazakhstani model of education. Improvement of the regulatory framework should be aimed at creating conditions for the sustainable development of educational organizations and the introduction of innovative forms of teacher training.

An equally important task is the integration of education, science and Industry, which involves the development of mechanisms for quadripartite interaction within the framework of the "School - University - Science - Industry" alliance. Support for the real sector of the economy in this context is considered as a factor in improving the quality of education, which makes it possible to bring the content of education closer to the current needs of society and the labor market.

Particular attention in the discussed model is paid to the introduction of innovations through project and research activities. Support for the development and implementation of innovative projects in the educational environment creates conditions for the formation of research skills, critical thinking and independent problem solving in schoolchildren and students. The formation of these competencies is the most important condition for the training of future specialists capable of scientific research and professional growth.

Within the framework of training teachers of the natural sciences, the problem remains the insufficient readiness of teaching staff for scientific activities, which is confirmed by the results of our study and the data of a number of scientific works S. Semenikhina, V. Semenikhin, Z. Kukenov, B. Sarimbayeva, R. Izimova (Semenikhina et al., 2024), Luo T., Zhao J., So W., Zhan W. (Luo et al., 2024).

In this regard, the need for purposeful training of future teachers to formulate research topics, develop scientific apparatus, and choose adequate methodology and methods of scientific research is actualized. Solving this problem is possible only with a systematic revision of the content and technologies of pedagogical education. The establishment of a stable relationship between school, university, science and Industry is one of the separate directions of the development of the educational system. The development and implementation of a set of measures aimed at the exchange of experience, joint project and research activities will make it possible to form an integral educational ecosystem focused on the training of competitive specialists A.V. Gam (Gam, 2020).

In the end, the implementation of the program of the alliance "School - University - Science - Industry" within the framework of project and research activities, as well as the creation of the Pedagogical Technopark are considered by us as effective tools for the formation of an integral pedagogical environment. Such an environment will ensure the continuity of teacher training, strengthen their scientific potential and improve the quality of natural science education at all levels.

The gaps in the system of secondary and higher education identified in the course of theoretical analysis, as well as the tasks formulated on their basis, allow us to determine promising areas for further scientific research. In particular, they

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include the identification of the capabilities of teaching staff in the natural sciences in the context of the alliance "School - University - Science - Industry", the search and analysis of the available resources and potential of teachers, as well as the development of effective methods for their retraining at the university level. The revision of educational programs for teacher training, taking into account the requirements of state programs and the goals of this study, will eliminate the identified gaps and ensure the sustainable development of teacher education. Table 1 presents the identified gaps in the education system, as well as their causes, and Table 2 presents the correspondence between the identified problems and the proposed research objectives (Table 1, Table 2).

Table 1 – Identified gaps in the education system and their causes

Level of education	Gaps identified	Reasons established in the study
Secondary education	Insufficient level of project and research skills of schoolchildren	Insufficient Preparedness of Teachers for Research Activities
Secondary education	Poor career guidance	Lack of stable connection between the school and the university, science and industry
Higher education	The Formal Nature of Scientific Training of Future Teachers	Limited integration of R&D into the educational process
Higher education	Low motivation of students for scientific activities	Lack of practice-oriented research forms of education
Secondary and higher education	Low adaptability to innovation	Lack of flexibility in the education system and regulatory frameworks

Table 2 – Correspondence of the identified problems and the proposed research objectives

Identified problems	Solution direction	Objectives
Lack of flexibility in the education system	Improving the regulatory framework	Democratization of education management, normative legal acts
Weak motivation for the quality of learning	Implementation of a quality assurance system	Stimulating innovation and research
Lack of sustainable research in schoolchildren	Project and research activities	Formation of research competencies
Teachers' Unpreparedness for Science	Training of teachers of natural sciences	Training in Research Methodology and Methods
Gap between levels of education	Formation of the School-University-Science-Industry Alliance	**Integration "School-University-Science-Industry"**

Here is a specific example of the level of activity in the field of innovation (from the source - the Committee on Statistics of the Ministry of National Economy of the Republic of Kazakhstan.

Statistical analysis of the main indicators of innovation activity from 2016 to 2025 showed that despite the annual increase in the number of enterprises in Kazakhstan, the level of innovation activity of enterprises and organizations remains at a low level (Figure 1).

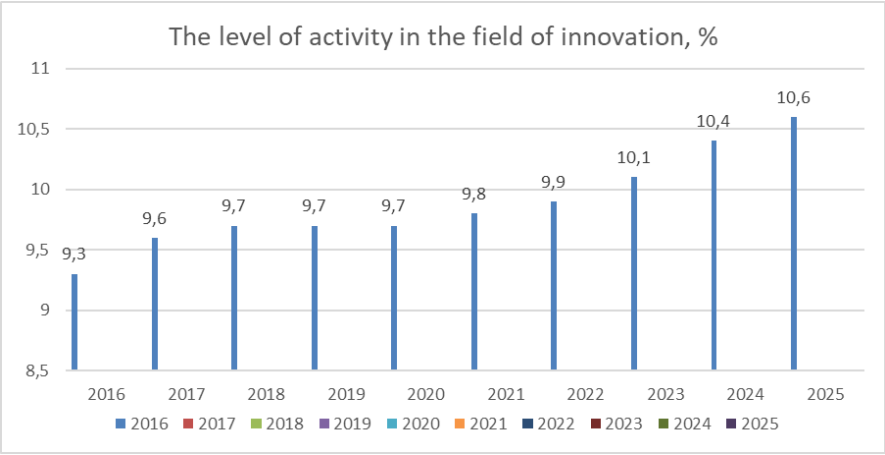

Figure 1 - Level of innovation activity

Based on the theoretical analysis, we propose a theoretical Model of interaction within the framework of the "School-University-Science-Industry" alliance, presented in Figure 2 (Figure 2).

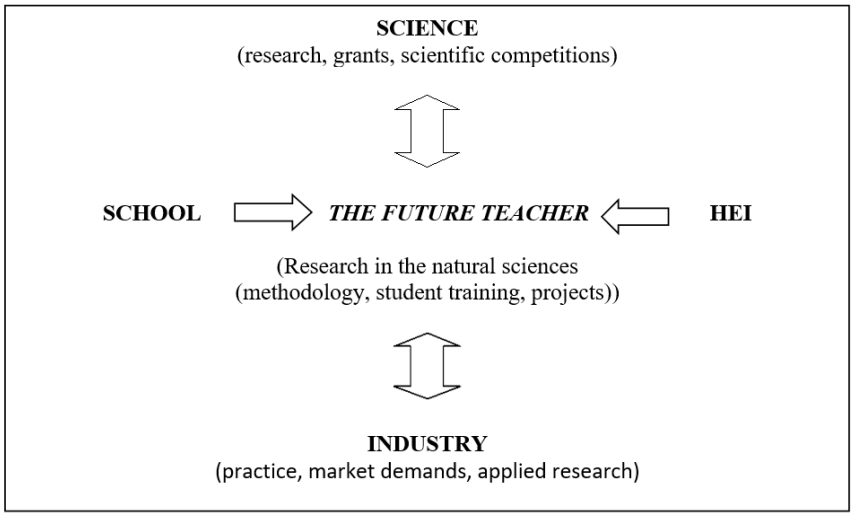

Figure 2 – Model of interaction within the framework of the alliance "School-university-science-Industry"

Conclusion. According to the theoretical review, in order to eliminate the gaps both in the system of secondary education (training of schoolchildren and the training of teaching staff) and in the system of higher education in the training of future teaching staff (in our case, future teachers of the natural sciences), we propose the following ways within the framework of the Aktobe Regional University named after K. Zhubanov:

1. Implementation of the alliance "School-university-science-Industry":

- Development and implementation of the alliance program in the integral pedagogical process of the university, aimed at training teachers of natural sciences.

- Elimination of gaps in the joint activities of school, university and Industry, such as the lack of joint projects and research, as well as the lack of trained teaching staff for the implementation of high-quality projects and scientific research.

2. Opening of the Pedagogical Technopark:

- Creation of the Pedagogical Technopark, which contributes to the unification of the alliance "School-university-science-Industry" and addressing the challenges at all levels of the alliance.

- Preparation of schoolchildren for scientific competitions, joint work with teachers on projects and research, as well as establishing relationships with production.

We see solutions for all representatives of the alliance:

For current teaching staff:

- Determining the scientific potential of teachers and conducting a comparative analysis of the readiness of teaching staff for design and research activities.

- Development of a retraining program on the basis of the university and its implementation in the educational process.

- Opening of the Pedagogical Technopark for joint work with the school and Industry.

For Students (Future School Teachers):

- Revision of the Modular Curriculum taking into account the gaps in the scientific potential of existing teaching staff.

- Introduction of new academic disciplines, courses and electives for better training of students.

For the production of:

- With regard to interaction with production, it is proposed to visit the main production sites in the city of Aktobe in the form of excursions for familiarization. Also, it is planned to invite representatives of production to conduct practical and laboratory classes on STEM technology, as well as the implementation of scientific experiments and other research activities on the basis of the university.

- For students, future school teachers, it is proposed to take into account the existing gaps in the scientific potential of the current teaching staff. This involves a revision of the Modular Curriculum (UP) of educational programs. The introduction of new academic disciplines, courses, electives or the creation of centers is aimed at filling these gaps.

- For alliance production "School-University-Science-Industry" It provides an opportunity to conduct "pointed" training of qualified specialists with the necessary competencies and other skills.

Thus, we offer recommendations for eliminating the gaps in the educational system presented in Table 3 (Table 3).

Table 3 – Recommendations for closing gaps in the education system

Level/Member	*Recommendations/measures*	*Expected result*
Education system (general level)	Implementation of the Alliance "School-University-Science- Industry"	Closing the gap between educational levels; improving the quality of training of teachers of natural sciences; creation of a holistic educational environment
Higher education (future teachers)	Revision of MUP and QED. Introduction of extended courses, electives and academic disciplines: mandatory participation of students in design and research activities (university technopark, greenhouses, proposed pedagogical quantorium)	Improving the scientific and project competence of future teachers; readiness to participate in scientific competitions and research
Current teaching staff	Analysis of scientific potential and readiness for research; development and implementation of retraining programs on the basis of the university; participation in the Pedagogical Technopark	Growth of professional competence of teachers; active participation in joint projects with the university and production
Schoolchildren	Preparation for scientific competitions, participation in joint projects with teachers and students; inclusion in the activities of the Pedagogical Technopark	Formation of research competencies, increasing motivation for scientific activities and career guidance
Industry / Enterprises of Aktobe	Organization of excursions to production sites; inviting representatives of production to conduct laboratory and practical classes; participation in STEM projects	Training of qualified specialists with practical skills; strengthening the links between the educational environment and the real sector of the economy
Alliance "School-University-Science-Industry" (general level)	Creation of the Pedagogical Technopark "Quantorium named after A.A. Kalyuzhny" to unite all members of the alliance and joint work	Ensuring comprehensive interaction of all participants; development of an innovative, research and project environment at all levels of the educational system

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