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From the experience of working on a new model of agrotechnical personnel training

Abstract. *The lack of integration between production, science and education is a systemic problem hindering the improvement of the quality of training of agrotechnical specialists. Outdated technologies, limited learning trajectory, insufficient material and technical base of Kazakhstan universities also negatively affect the education process. As a result, the level of training of graduates often does not meet modern requirements. To modernize educational programs and the level of teaching, it is necessary to link scientific research, training and the introduction of new technologies in the agro-industrial complex, synchronization of domestic innovative developments together with the transfer of successful foreign technologies in the field of education. Currently, there are problems with the natural science training of students both in secondary educational institutions and in higher education in Kazakhstan. This is evidenced by many studies on the monitoring of students' academic achievements both within the country and abroad, by organizations such as PISA (Program for International Student Assessment) and TIMSS (Trends in Mathematics and Science Study). The article considers one of the approaches to improve the natural science training of students in order to provide a basic level of training of bachelor's degree specialists in several areas of agrotechnical profile. The new model of training specialists is based on in-depth study of fundamental disciplines such as physics, chemistry, biology, higher mathematics and computer science. In the conditions of on-line training, a virtual multimedia environment built into the educational platform is used.*

Keywords: *Pilot project, basic disciplines, interdisciplinary approach, Kazakh-French educational project, electronic journal, learning environment, content, curriculum.*

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Introduction

Kazakhstan's higher education system is characterized by the following features: low level of State funding, inefficient allocation of this funding, the impact of centralized management on the work of higher education institutions, as well as insufficient data, which creates obstacles to the implementation of evidence-based policies and accountability. Kazakh universities have relatively low indicators compared to advanced Western universities, such as academic reputation, image among employers, citation, the number of foreign teachers and students. The maximum citation score of Kazakhstani universities is 1.4, while universities from the top 200 have from 51.6 to 100 points [1]. This leads to the conclusion that Kazakhstan's education system needs to be reorganized and adapted to modern conditions [2]. Over the past decade, the country's top

leadership has recognized these problems as key and identified measures to eliminate them. The Republic has started implementing a set of reforms aimed at solving these problems [3].

A number of foreign experts [4], investigating master's degree training in Kazakh universities, came to the conclusion that the main problem of the low level of training of undergraduates lies in the system of bachelor's degree implementation. In Kazakhstan universities, during the transition from a five-year cycle of training specialists to a four-year period of bachelor's degree preparation, the period of study of general scientific disciplines was significantly reduced, switching to specialization relatively early. This circumstance has affected the quality of training of bachelors who are experiencing certain difficulties when entering foreign master's and doctoral programs. A reduction in the duration of training in general scientific disciplines, primarily in the natural sciences, is also observed in a number of countries of the former Soviet Union, which led to a catastrophic decrease in the level of training of specialists in engineering specialties.

Problem statement and research methods

As international practice shows, any innovation should be based on a clear scientific and methodological basis on the principle of «study - test – implement». The pilot project of bachelor's degree training implemented since 2020 within the framework of the cooperation agreement between the S. Seifullin Kazakh Agrotechnical University (KazATU) and AgroParisTech Agricultural University (France) It is aimed at the transformation of the educational process of KazATU with a view to the subsequent transition to a double-degree education.

AgroParisTech is one of the top universities in France, which belongs to the highest and most prestigious schools of the Grand Ecole. In 2021, the university ranked 3rd in Europe and 4th in the world as the best university in the field of agriculture and forestry [5]. Such cooperation with the leading agricultural university of France is taking place in Kazakhstan for the first time. On September 1, 2020, by the Decree of the Government of the Republic of Kazakhstan, S.Seifullin KazATU was awarded the status of a

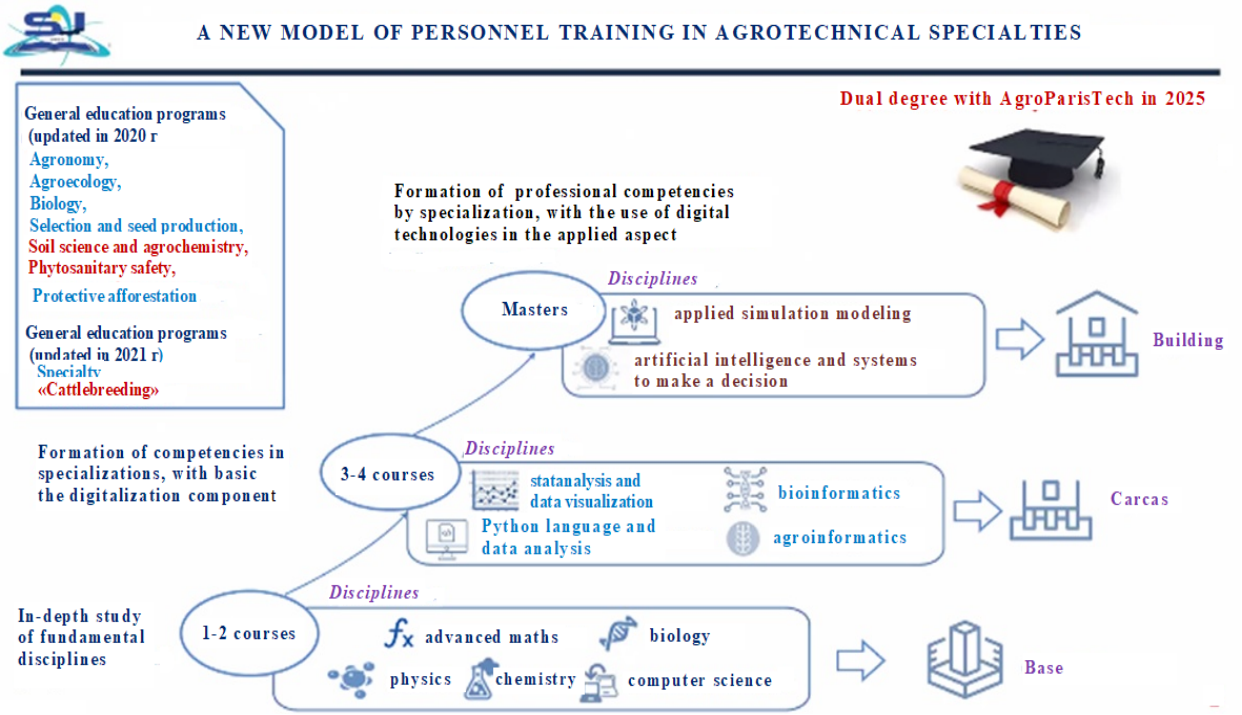

Figure 1. A new model of personnel training in agrotechnical specialties

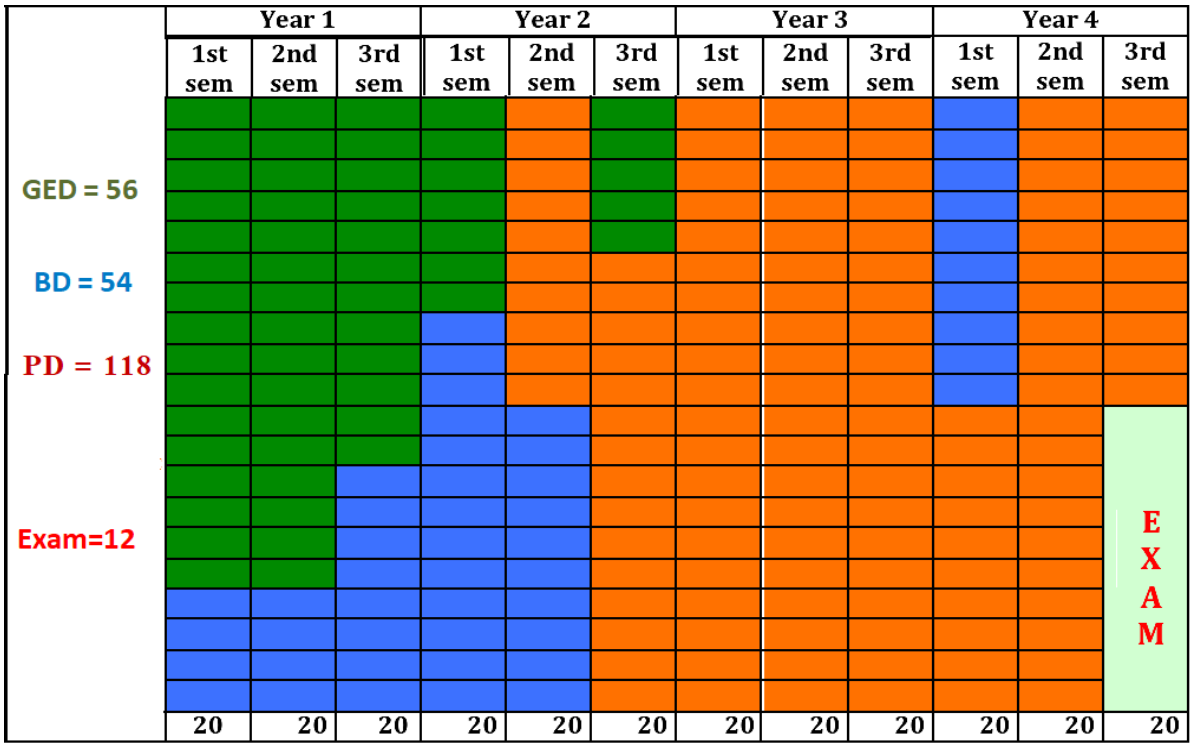

Figure 2. Bachelor's degree program before pilot project

research one. As part of the implementation of this Resolution, the University adopted a new model of training personnel in agrotechnical specialties [6].

The model is based on an in-depth study of fundamental disciplines such as physics, chemistry, biology, higher mathematics and computer science. The specialist training program provides a balance between deep knowledge and understanding of these subjects and helps to develop the skills necessary for students to take their next steps in education or employment, to train highly qualified agricultural specialists [7]. In accordance with the agreement, all educational programs on agricultural specialties of KazATU (at the first stage – on animal husbandry, plant protection and quarantine, soil science) will be transformed to the standard of developed countries. In order to transfer knowledge, KazATU teachers will take special courses at AgroParisTech University. At the same time, with the help of French scientists, new training programs will be developed and introduced into the educational process, allowing to train personnel of a new format. The implementation of this project will be completed in 5 years with the transition to a double-degree education, i.e. diplomas issued by a Kazakh university will be identical to AgroParisTech university diplomas.

The pilot project with AgroParisTech provides for the modernization and significant renewal of departments providing in-depth study of natural sciences. Figures 2 and 3 illustrate the educational programs for the preparation of bachelors of agrotechnical profile at the Faculty of Agronomy before the implementation of the pilot project and after.

Here the abbreviation OOD means general education disciplines, DB - basic disciplines, PD - profile disciplines. The educational training program in the pilot project provides for thorough training of bachelors in basic disciplines, closer connection with the block of core disciplines. For 4 years of preparation, students master 240 credits, 20 credits in each trimester. Each credit includes 10 hours of lectures and 20 hours of laboratory and practical classes.

The colors in the figure illustrate more thorough training in basic fundamental disciplines in the pilot project. Prior to the

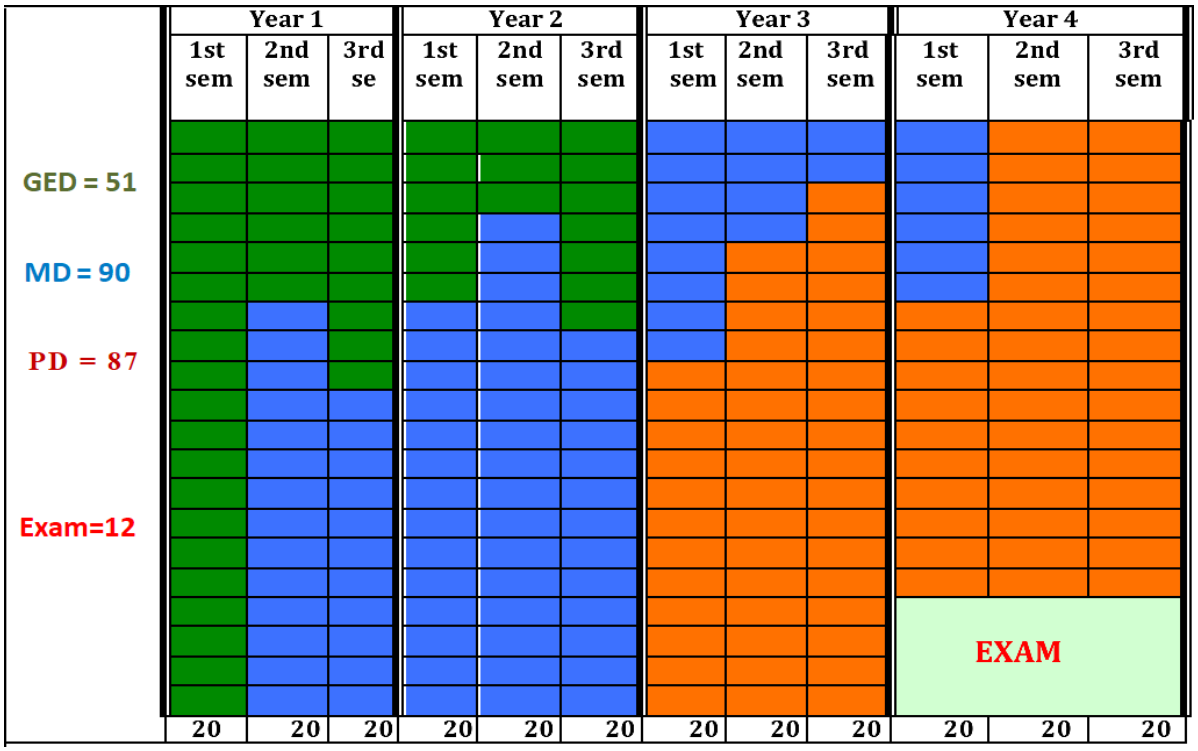

Figure 3. The educational program of the bachelor's degree of the pilot project

implementation of the pilot project, the share of general education disciplines accounted for 25%, basic disciplines - 21% and profile disciplines accounted for 54% of the total number of credits. After the implementation of the project, the share of general education disciplines decreased to 22%, basic disciplines almost doubled, to 40% and the share of core disciplines decreased to 38% of the total number of credits. In addition, general education and basic disciplines were studied earlier mainly in junior courses. Now, the basic disciplines are included in the educational program throughout all four courses of study.

In the course of the study, the educational program of bachelor's degree preparation is tested; content is prepared in basic disciplines such as physics, chemistry and interdisciplinary connections between them are established. The connection of the content with the direction of training is determined, the relationship with the profile disciplines is strengthened.

The pilot project being implemented at the university has many similarities with the national model of STEAM education being formed in the republic [8]. What is the difference between STEAM education and the traditional way of learning? STEAM education provides integrated teaching of several subjects: Science, Technology, Engineering, Art and Mathematics (S - Science, T - Technology, E - Engineering, A - Art, M - Mathematics) and is widely taught in leading educational institutions of the world. The STEAM project is aimed at developing students' creative and artistic thinking, cooperation, social intelligence, the ability to use innovative technologies using various programming languages, as well as to put into practice the knowledge they have gained by creating something new [9-10].

A joint Kazakh-French project solves similar tasks. This is an interdisciplinary approach in which scientific, technological, engineering, mathematical disciplines, as well as art, are considered interconnected, which allows you to study them much deeper. When we consider some aspects of physics through chemistry, and through physics we delve into mathematics, and through mathematics into all other areas, then we learn the subject being studied much more widely and functionally.

Results and Discussion

In the 2020-2021 academic year, 7 educational programs were prepared at KazATU, which train bachelors under the new model. All of them have been approved and entered into the register of educational programs of the Ministry of Education and Science (MES) of the Republic of Kazakhstan. Almost the entire set of the first year of the Faculty of Agronomy began to study according to the new model. The only exceptions were a few groups of students enrolled in a shortened post-college program and in some programs, such as Environmental Management. French colleagues, acting as project consultants, advised to select one group on which they could test a new system of student education. In addition, compared with the number of hours per 1 credit recommended by the French, the number of laboratory and practical classes has been reduced.

The beginning of the pilot project implementation, according to the new model of training personnel of agrotechnical specialties, coincided with quarantine restrictions due to the incidence of coronavirus in the country. In the conditions of a pandemic in the republic, distance learning was introduced in universities. In the discipline of physics, such a transition did not cause any special problems, because the department had gained experience in using distance learning technologies. For several years, research has been carried out within the framework of the scientific project «Research, development of a virtual educational space and software products for an Online distance learning system». The object of the study was a virtual educational space, which is a rapidly developing, multi-level and multifunctional system combining methodological and pedagogical technologies, information resources and modern software. Other departments, in addition to departments related to computer science, experienced certain difficulties, because on-line learning is integrated into the educational space with digital technologies that had to be hastily mastered and tied to disciplines.

Within the framework of this project, a model of a virtual educational environment for general education disciplines was developed, with the creation and implementation of software products in the educational process with the integration of real and virtual processes and resources of educational activities based on the use of e-learning tools, information and telecommunication technologies that provide the possibility of continuous updating of educational content. It was possible to create high-quality content on general scientific disciplines within the framework of the international agreement on scientific and methodological cooperation between S.Seifullin KATU and Lomonosov Moscow State University» (Faculty of Physics) [11].

The main problems with online learning were the quality of computer equipment, low Internet traffic speed, the complexity of learning at home and the lack of direct contact with teachers and fellow students. Laboratory work was carried out in a virtual laboratory, which required students to install appropriate software products and teach students the rules of their use, as well as safety issues and rules of work in a virtual laboratory. A lot of questions are raised by the admission of students to laboratory work, their preparation, an objective assessment of the quality of work in the ZOOM conference mode, the performance of tasks during practical classes. Analysis of students' reports on completed assignments indicates numerous cases of cheating and plagiarism due to the remote format of classes.

The data of the electronic journal in the Platonus automated information system (AIS) make it possible to trace how the academic achievements of students changed during the trimester. Table 1 shows the average current scores of students from 3 to 10 weeks, which are based on the results of laboratory work assignments, practical classes, independent work of students, according to the sections of the syllabus (work program of the discipline). In addition, the current control of knowledge in the sections of the discipline Fundamentals of Physics was carried out, and in the penultimate 9th week with proctoring, i.e. using technology that allows

Table 1. Electronic examination and rating sheet for the discipline Fundamentals of Physics group 20-03, 2020-2021 academic years

№	Full name	Average score in the 3rd week	Average score in the 6th week	Average score in the 8th week	Testing with proctoring	Average score in the 10th week	Final control
1	2	3	4	5	6	7	8
1	A.R.B.	52	60	61	41	58	61
2	A.A.M.	62	64	63	62	63	71
3	A.T.M	53	57	67	-	65	63
4	A.A.T.	19	17	24	62	30	Not admitted
5	A.M.T.	50	55	58	65	61	65
6	A.A.A.	37	37	43	15	37	Not admitted
7	A.A. B.	69	69	73	76	76	72
8	B.A.M.	67	71	74	53	72	71
9	B.M.B.	69	69	74	56	72	73
10	E.D.S.	63	62	63	32	60	68
11	Z.S. S.	67	72	78	65	77	85
12	K.D.E.	76	79	79	62	77	76
13	HOW.	60	57	67	32	64	65
14	K.K.I.	70	61	73	56	73	70
15	K.M.R.	57	57	58	-	48	53
16	M.G.K.	63	65	66	59	62	65
17	M.A.O.	65	66	67	53	66	61
18	G.A.A.	60	58	72	85	74	80
19	M.T.T.	38	39	40	-	40	Not admitted
20	M.E.E.	55	57	60	53	59	63
21	N.T.U.	55	56	62	50	63	69
22	P.M.I.	55	55	62	47	49	Not admitted
23	R.M.I.	60	64	69	53	59	72
24	SYN.	50	53	55	-	44	57
25	S.R.Zh.	60	58	63	74	64	74
26	S.D.I.	60	70	73	65	61	63
27	T.A. S.	60	67	68	-	54	FX
28	H.B.B.	37	38	38	-	38	Not admitted
29	Kh.S.Zh	20	23	34	-	35	Not admitted
30	Kh.M.N	55	57	60	41	47	51
31	Sh.S.Zh.	60	61	67		55	67
32	Sh.R.A.	69	73	74	47	71	74

you to verify and monitor students during online testing. The scores in column 6, marked in red, are marked by AIS as suspicious, the Proctor can view the video recording of the student's testing and cancel the results if they are in doubt. By the way, only five students were tested by the system without violations, the remaining 19 were indicated by the system as violators. The average test score with proctoring was 48 points. A week before the proctoring, during testing, students

Table 2. Average current grades of students of the group 20-03, 2020-2021 academic years

№	Discipline	Average current estimate	Number of passes in hours
1	Higher mathematics	61.87	38
2	Fundamentals of Physics	60.12	53
3	Molecular and Cell Biology	62.38	50
4	Foreign language	66.39	18
5	Inorganic and organic chemistry	51.22	30
6	Kazakh (Russian) language	70.73	29
7	Information and communication technologies	66.06	4

showed a fairly high average score = 65, which indicates dishonest behavior of students during online knowledge control.

Students who have not completed the curriculum and have scored an average current score based on the results of mastering the theoretical course, performing laboratory and practical exercises and monitoring independent work during the trimester on all topics less than 50 points are not allowed to take exams and can complete the curriculum and pass the exam during an additional summer session. Students who have received an FX score on the final control, i.e. a score between 26 and 49, can retake it within a week by the decision of the appeals commission.

Students' academic performance in the disciplines studied in the second trimester of the 2020-2021 academic year can be estimated by the average current grades in the same group based on the results of seven weeks of study (Table 2).

These tables indicate the average academic performance of students. The omissions in the group are made up of the same students, who make up about 18% of the total number of students. The same students who miss classes and consequently do not fulfill the curriculum are not allowed to the final control. Those of them who have valid reasons (were ill, were away and could not return due to quarantine restrictions, etc.) can work out passes on an individual schedule. Many students are graduates of rural schools, which affects their level of training. Naturally, when conducting lectures, laboratory and practical classes, the level of preparation of the student audience was taken into account, when admitting to laboratory classes, more time was devoted to explaining tasks and demonstrations. When checking the task reports through the Platonus automated information system, students were given detailed individual consultations. Some students complained about the overload of tasks, because classes were conducted in on-line learning mode, which, of course, affected the quality of training. Therefore, it is necessary to revise the structure of tasks, focusing not on their quantity, but on quality. There were complaints about weak Internet, frequent blackouts, lack of computer equipment, lack of WEB cameras, etc.

Conclusion

In all natural science disciplines there are general schemes that form the basis for the formation of scientific conclusions. They all use scientific facts and evidence. An important component of the professional competence of a future specialist is the ability to argue and analyze the data obtained in order to correlate them with existing theories. Today, everyone agrees that natural science education helps students to better understand the basics of the studied specialized disciplines [12].

The beginning of the implementation of the pilot project of a new model of education at the university coincided with the period of the

coronavirus pandemic in the republic, which left a certain imprint on the learning process. If some of the most prepared students enthusiastically accepted the model, systematically prepared for classes, regularly completed all tasks, then less prepared students with weak knowledge and skipping classes expressed a desire to return to the old, traditional system of education. Therefore, it took the efforts of teachers, advisors, faculty administration to explain the principles and goals of the new program.

The first results of the implementation of the pilot project of Kazakh-French training allow us to hope that they will provide basic training for future specialists in the agrotechnical field. Of course, they will not be physicists or chemists, mathematicians or biologists, but interdisciplinary knowledge will allow them to solve problems in their chosen specialty in the future. Already now they have learned how to use software products in a virtual environment, can apply error theory to process measurements and build simple schemes in physics classes using mathematical knowledge or computer skills. The teacher already has to link the topics of classes in fundamental disciplines with the areas of professional training.

In order to increase the level of fundamental training of students in accordance with the educational standard and strengthen natural science training, it is necessary to increase the hours of laboratory and practical classes (and in practice they were reduced), possibly at the expense of theoretical ones, which is consistent with the model of STEAM education. It is necessary to modernize the laboratory equipment of natural science departments. Motivation of students plays an important role, since the new learning model requires significant efforts on the development of curricula, both on the part of students and teachers.

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Агротехникалық профильде мамандар дайындаудың жаңа моделі бойынша жұмыс тәжірибесінен

Аңдатпа. Агротехникалық профильде мамандар дайындау сапасын жақсартуға кедергі келтіретін жүйелі мәселе болып өндіріс, ғылым және білім беру арасындағы интеграцияның болмауы болып табылады. Сонымен қатар, ескірген технологиялар, білім берудің шектеулі траекториясы, қазақстан университеттерінің материалды-техникалық базасының жетіспеушілігі білім беру процесіне теріс әсерін тигізеді. Салдар ретінде, бітірушілердің білім алу деңгейі көп жағдайларда заманауи талаптарға сәйкес келмейді. Білім беру бағдарламаларды және білім беру деңгейін дамыту үшін ғылыми зерттеулер мен кадрлар дайындау арасындағы байланыс және агроөндіріс кешенінде жаңа технологияларды еңгізу, дамыған шет елдік технологияларды еңгізе отырып білім беру саласында отандық инновациялық жаңалықтардың синхронизациясы қажет. Қазіргі таңда Қазақстанның орташа білім беру және жоғарғы білім беру орындарында жаратылыстануды оқыту мәселелері туып отыр. Осы жайлы PISA (Program for International Student Assessment) және TIMSS (Trends in Mathematics and Science Study) сияқты ұйымдардың өз елімізде және шет елдердегі оқушылардың білім алу жетістіктерінің мониторингі бойынша зерттеулерде әңгіме қозғалды. Мақалада агротехникалық профильдің бірнеше бағыттарындағы бакалавриат мамандықтарын дайындаудағы базалық деңгейді қамтамасыз ету мақсатында жаратылыстануды оқытуды жоғарлатудың тәсілдерінің бірі көрсетілген. Мамандарды дайындаудағы жаңа моделінің негізінде физика, химия, биология, жоғарғы математика және компьютерлік ғылымдар сияқты фундаментальды пәндерді тереңдетіп оқыту жатады. On line оқыту жағдайында білім беру платформасына еңгізілген виртуалды мультимедиялық орта пайдаланылады.

Түйін сөздер: Пилоттық жоба, базалық пәндер, пәнаралық көзқарас, қазақ-француз білім беру жобасы, электронды журнал, оқу ортасы, контент, оқу бағдарламасы.

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Из опыта работы по новой модели подготовки кадров агротехнического профиля

Аннотация. Системной проблемой, препятствующей улучшению качества подготовки специалистов агротехнического профиля, является отсутствие интеграции между производством, наукой и об-

разованием. Устаревшие технологии, ограниченная траектория обучения, недостаточная материально-техническая база казахстанских университетов также негативно влияют на процесс образования. Как следствие, уровень подготовки выпускников часто не соответствует современным требованиям. Для модернизации образовательных программ и уровня преподавания необходима связь между научными исследованиями, подготовкой кадров и внедрением новых технологий в агропромышленном комплексе, синхронизация отечественных инновационных разработок вместе с трансфертом успешных зарубежных технологий в области образования. В настоящее время существуют проблемы естественнонаучной подготовки обучающихся как в средних учебных заведениях, так и в высшей школе Казахстана. Об этом говорят многие исследования по мониторингу учебных достижений учащихся как внутри страны, так и за рубежом, такими организациями как PISA (Program for International Student Assessment) и TIMSS (Trends in Mathematics and Science Study). В статье рассматривается один из подходов для повышения естественнонаучной подготовки студентов с целью обеспечения базового уровня подготовки специалистов бакалавриата по нескольким направлениям агротехнического профиля. В основе новой модели подготовки специалистов лежит углубленное изучение фундаментальных дисциплин, таких как физика, химия, биология, высшая математика и компьютерные науки. В условиях on-line обучения применяется виртуальная мультимедийная среда, встроенная в образовательную платформу.

Ключевые слова: Пилотный проект, базовые дисциплины, междисциплинарный подход, казахстанско-французский образовательный проект, электронный журнал, среда обучения, контент, учебная программа.

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