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INTEGRATION OF EDUCATION AND SCIENTIFIC RESEARCH IN AN EDUCATIONAL INSTITUTION

Abstract

The article deals with the problem of differentiation and scientific research of scientific knowledge in chemistry at the university. The strategic foundations of science and education incorporation in modern society are presented, together with the main objectives and tasks to enhance their collaboration. The combination of science and education on the foundation of universities has been formed as a multifaceted process, involving the construction of a global data environment, a unified educational space, and the employment of various new teaching methods.

One of the research disciplines of chemistry at the university was chosen as a model for studying the mechanisms of integration and differentiation. The relational integration of various fields of knowledge and scientific research in chemistry is considered in detail.

The paper exposes the issues that initiate the procedure of combining pedagogical education with science; reveals the areas of work of the department that contribute to the development of scientific research and interaction of the educational process; proposes new fundamental and comprehensive professional skills required for the construction of upcoming bachelors and masters of pedagogical education ready for an innovative combination of knowledge and scientific activity centered around the exploration of the field; educational and analyzed ways to improve the effectiveness of the pedagogical university in the integration of research works are proposed.

The purpose of the article is to offer an opportunity to study chemical theories, to develop knowledge and scientific and theoretical knowledge of universities.

Keywords: integration, research work,integration of science and education, competence, deepening integration.

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ИНТЕГРАЦИЯ ОБРАЗОВАНИЯ И НАУЧНЫХ ИССЛЕДОВАНИЙ В ОБРАЗОВАТЕЛЬНОМ УЧРЕЖДЕНИИ

Аннотация

В статье рассматривается проблема дифференциации и научного исследования научных знаний по химии в вузе. Описаны Стратегические основы интеграции науки и образования в современном обществе, а также основные причины и задачи совершенствования их сотрудничества. Установлено, что соединение научных знаний со сферой образования, базирующееся на университетах, представляет собой сложный процесс, включающий в себя развитие мировой информационной среды, создание общего образовательного пространства и использование разнообразных инновационных методик обучения. В качестве модели изучения механизмов интеграции и дифференциации была выбрана одна из научно-исследовательских дисциплин химии в вузе. Подробно рассматривается реляционная интеграция различных областей знаний и научных исследований химии.

В статье обсуждаются вопросы, способствующие объединению педагогического образования и науки. Также исследуются направления деятельности кафедры, способствующие развитию научных исследований и сотрудничеству в образовательном процессе. Представлены новые общие навыки, необходимые для подготовки будущих педагогов к сочетанию знаний и научной деятельности. Рассмотрены пути повышения эффективности педагогического университета при интеграции исследовательской работы.

Цель статьи-предложить возможность изучения химических теорий, развить знания и научно-теоретические знания вузов.

Ключевые слова: интеграция, научно-исследовательская работа, интеграция науки и образования, компетентность, углубление интеграции.

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БІЛІМ БЕРУ МЕКЕМЕСІНДЕГІ БІЛІМ БЕРУ МЕН ҒЫЛЫМИ ЗЕРТТЕУЛЕРДІҢ ИНТЕГРАЦИЯСЫ

Аңдатпа

Мақалада жоғары оқу орнындағы химиядағы ғылыми білімнің сарапануы мен ғылыми зерттеу мәселесі қарастырылған. Қазіргі қоғамдағы ғылым мен білім беруді интеграциялаудың стратегиялық негіздері, сондай-ақ олардың ынтымақтастығын жетілдірудің негізгі себептері мен міндеттері сипатталған. Университеттер базасында ғылым мен білім берудің интеграциясы жаһандық ақпараттық ортаны, бірыңғай білім беру кеңістігін дамытуды және оқытудың әртүрлі инновациялық әдістерін қолдануды қамтитын көп деңгейлі процесс екені анықталды.

Интеграция және саралау механизмдерін зерттеудің үлгісі ретінде жоғары оқу орнындағы химияның ғылыми зерттеу пәндерінің бірі таңдалды. Химия пәнінін білім мен ғылыми зерттеудің әртүрлі салаларының реляциялық интеграциясы егжей-тегжейлі қарастырылады.

Мақалада педагогикалық білім мен ғылымды интеграциялау процесін жандандыратын мәселелер ашылады; ғылыми зерттеулерді дамытуға және білім беру процесінің өзара іс-қимылына ықпал ететін кафедра жұмысының бағыттары ашылады; болашақ педагогикалық білім беру бакалаврлары мен магистрлерінде пәнді зерделеуге негізделген білім мен ғылыми қызметтің шығармашылық үйлесіміне дайындықты қалыптастыру үшін қажетті жаңа әмбебап және жалпы кәсіби құзыреттер ұсынылады; білім беру және ғылыми-зерттеу жұмыстарын интеграциялау кезінде педагогикалық университеттің тиімділігін арттыру жолдары талданады.

Мақаланың мақсаты химиялық теорияларды зерттеу мүмкіндігін ұсыну, жоғары оқу орындарының білімі мен ғылыми-теориялық білімін дамыту.

Түйін сөздер*:* интеграция, ғылыми-зерттеу жұмысы, ғылым мен білімнің интеграциясы, құзыреттілік, интеграцияны тереңдету.

Introduction. Currently, the knowledge system is associated with the processes of its differentiation and integration. Integration leads to the emergence of new methods and theories, a

fundamental change in the structure and content of sciences. The integration refers to the procedures which result in the integrity, cohesiveness, and regularity of scientific information components such as objects, techniques, and ways to conduct research, as well as scientific theories which serve a particular part in the incorporation of different kinds of knowledge into specific systems of integration and are distinguished by differentiation. These are two oppositely directed processes of forming a unified scientific knowledge.

Integration is the development of scientific thinking and human attitude today, associated with the unification of parts and elements of each kind. Integration of sciences is mutual penetration, synthesis, unification of disciplines, their methods, elimination of boundaries between them.

The combination of research and education at universities is related to the overall upgrading of the country's educational systems. Education is regarded as one of the most important components in the growth of humanity and a prerequisite for growing its intellectual potential. First and foremost, it is to provide undergraduate students with the values underlying their research. Because of the interdependence of educational and research activity, students are able to participate in individual scientific work, independent search, and master's research work.

Basic provisions. Novel approaches to integrating science and education in colleges and universities take into account the success of experimental studies. The goal of integrating science and education is to develop an environmentally friendly system of education by relationships between the scientific and educational spheres based on finance, management, and other projects.

Based on the studies under consideration, clarifications were made : "developing self-study skills and making positive changes in the scientific pedagogical direction", "opening the way for new searches".

Materials and methods. Nowadays, taking into account integration as the primary path of advancement in society, science, and education, it should be pointed out the significance of establishing the conditions that are required for the greatest effective achievement of integration in education. Its impact on raising the expectations of university-based specialized learning.

A.V.Tchaikovsky advocated studying scientific information from the perspective of a parametric variation of separation and integration [1]. A.I.Uemov and G.V.Stukser suggest describing the authenticity and basic independence of organizations utilizing network descriptions. [2,3]. The works of M.S.Asimov and A.Tursunov [4], Yu.A.Zolotov [5], N.T.Kostyuk, V.S.Lyutaya, V.D.Beloguba [6], L.S.Sycheva [7], M.G.Chepikov [8] for differentiation and integration in natural science education.

V.I.Shyarnas contends that integrating is an interconnected and interdependent combination of theoretical understanding, work abilities, objectives, assignments, and educational types in the instruction of professionals, and determines the role of an expert system of training in an innovative manner according to the concept of integration in the field of vocational education. According to O. L.Sergeev, this is due to the study of the influence of achievements in science, technology, and culture on the formation of a list of specialties.

The fundamental work in this direction is N.K.Chapaev's dissertation research "theoretical and methodological foundations of pedagogical integration". The leading feature of integration is "the unity of the process and the result in the process of its implementation" [9].

The main argument for integrating science and education is to establish a successful framework for the growth of the basic disciplines by academics from research centers and universities through enhancing educational quality while creating novel ways of educational process organization. P. Lerner also interprets the idea of integrating as a pedagogical paradigm. "Currently, the defining trend of the cognitive process is integration. Integration is often a process and result of combining elements of the content of education to enhance the integrity of the system of knowledge, skills and abilities of students" [10].

An urgent task is to create the possibility of integrating students' knowledge in order to develop their competencies. The purpose of this study is to analyze the practical experience of universities

in carrying out a number of activities aimed at integrating scientific, educational and industrial structures and determining the future. To accomplish the objective, complete the subsequent tasks:

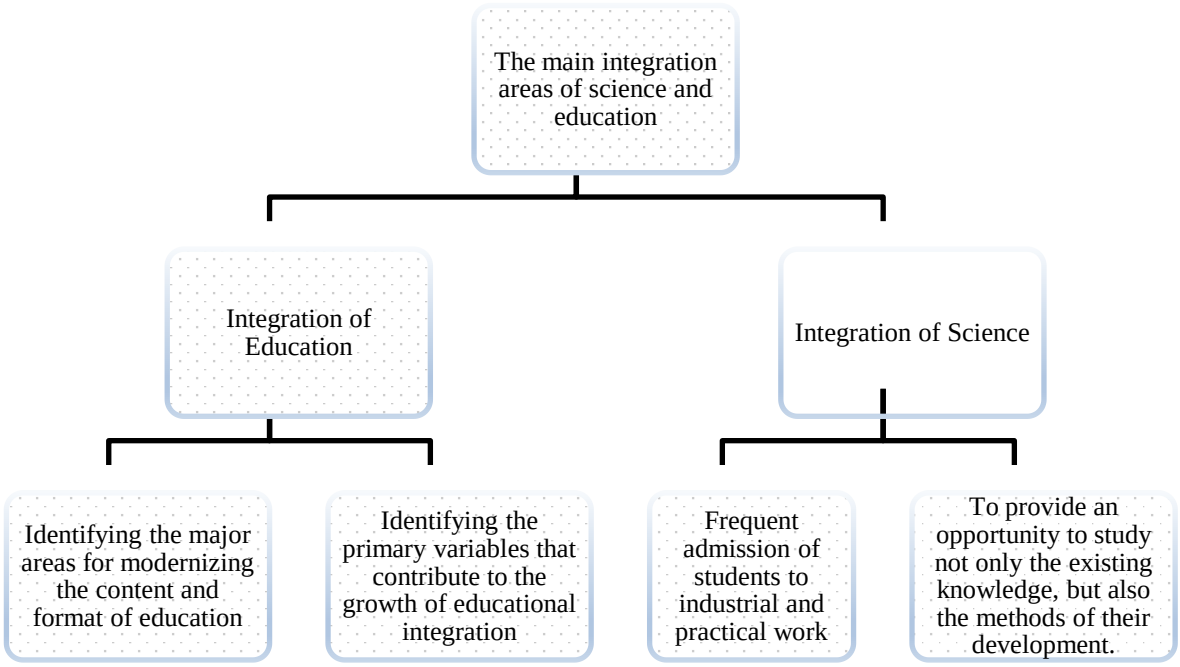

Figure 1 – The main integration areas of science and education

Training for a university that has selected an advantageous and rapid path that enables you to study both already prepared knowledge and absorption methods. Additionally, it should be remembered that one of the most significant developments in the evolution of the pedagogical education system is an upgrade in the unity of the content of education to competence-based [4,5].

Researching as an essential part of pedagogical education is carried out indirectly – by learners, graduate students, educators, and scholars, within the structure whereby knowledge management, operational, educational, financial, and other concerns are intertwined:

1) Improve and strengthen the connection between administrative and pedagogical learning and science.

2) Determine appropriate educational formats, approaches, techniques, and technology.

3) Expansion of scientific study in the fields of increasing cooperation, growth in pedagogical education, and science.

4) Establish a unified scientific and educational regulation for integrating education and science in a higher academic learning organization.

5) Create and examine instructive, methodological, and research materials (particular classes, the author's lessons, applications, etc.) to promote integration between education and science for learners and educating workforce. [2].

The faculty of science is the university's primary instructional and research division, as well as the focal point for methodological research. The department provides direct instruction and instructs pupils. He creates programs for the subjects allocated to him, decides on the right methods and techniques of instruction, organizes instructional resources, organizes courses as specified in the course of study, and depends on the student composition that matches his profile. The administration's efforts to integrate educational and research work are directed at managing scientific studies in the context of thorough examination of educational and scientific cooperation; acquiring suggestions on the implementation of the findings that science has gathered; and

introducing techniques that utilize them in organizations of higher professional instruction and institutes (courses) that offer advanced learning.

To achieve the objective, the following tasks must be completed:

- Expanding the cooperation of informative understanding and science, giving into consideration future teacher specialty and the development of study in the the discipline of approaches of application in the intellectual procedure.

- Implementing a solid academic and learning regulations in higher instructive education to increase the the beginning of essential information and science.

- The expansion of collaboration between science and learning (exclusive classes, the author's classes, etc.), the development and monitoring of instructive, methodological, and scientific resources to increase teaching staff capabilities for both bachelor and advanced programs[3]. The article considers the integration of theoretical and research skills of undergraduate students in the discipline "Chemical Technology".

The integration of knowledge and science in chemistry lessons is expressed in the ability of students to implement and develop research skills, applying the theoretical knowledge gained in laboratory classes. In order to identify the formation of students' research skills, the criteria determining the formation of research competencies were clarified.

Table 1. Assessment of students' research skills

Evaluation components	Description of indicators
Relevance	Be able to update the research work with current controversial issues
Be aware	Be able to use available sources on the issue under study and have a message about it
Independence	Ability to independently perform the entire stage of research work, draw conclusions
Creative	Show creativity using their point of view in solving a research problem
Ability to present in public	Ability to present a research paper or the result of laboratory work in the form of a presentation or thesis
Reflection	Personal attitude of the student to research work

Results. The article can consider the integration of theoretical and research skills of university students in the disciplines of "Inorganic Chemistry", "Analytical Chemistry" and "physico-chemical research methods" in the training of professionals in the discipline "Chemical Technology". These disciplines complement each other in the learning process and enhance students' search skills. The fundamentals of chemical knowledge are covered in the initial semester of the first year in the "inorganic chemistry" lessons to enhance competence as professionals, establish the capacity to generate novel inorganic materials and carry out research in science, regular legislation, basic components that include homoatomic materials, radioactive and generated components, the discipline of metallochemistry, and complicated chemical compounds are covered. Learners improve their conceptual and practical analytical abilities while also increasing their mental and imaginative behaviors.In the subsequent course, the lesson "Analytical Chemistry" analyzes the fundamental techniques for chemical testing (titrimetric, gravimetric), isolation and concentrate procedures, metrological issues, and chemistry examination products. Practical lessons are designed to familiarize learners with diagnostic experimentation techniques, as well as to develop the abilities required for job experience on current analytical instruments utilizing different chemical analysis methodologies.

In the third year, the field of "physico-chemical research methods" aims to comprehend the theoretical underpinnings and practical applications of contemporary practical study techniques used to describe and solve chemical challenges. Learners gain understanding and skills which

enable them to employ physicochemical methods to perform chemical studies and gather information regarding the physical parameters of molecules and qualities of compounds as they learn the field of study.

In the fourth year of the "Chemical Technology" subject, learners learn the fundamentals of chemical thermodynamics and kinetics in inorganic synthesis, basic methods of raw material preparation and purification, effective methods of extracting simple and complex substances from the elements of the periodic table in laboratory and production conditions are considered. Research experience is conducted within the framework of this discipline.As a result of the interrelation of educational and research work, students, in addition to mastering research work, can independently engage in scientific work, engage in independent search work. In the research lesson, students master the methodology of scientific research, master the stages of scientific knowledge, learn how to formulate and solve research problems.

Table 2. The formation of the ability to integrate knowledge in order to develop students' competencies

Experience content	**Nodal integrations**	**Key competencies**
The history of the discovery of humic acid	Formation of skills and habits	The capability to conduct searches in numerous databases, collaborate within a team, and increase knowledge autonomously
The structure of humic acid and the classification of humic substances	Know how to link structure, real estate and consider the impact of classification on it	Formation and systematization of core competencies
Composition and function of humic acid	Explanation of the dependence of the composition on the property using the functions performed	Formation and systematization of core competencies
Humic acids and their properties	Allows you to do search work on your own	Competence to independently improve knowledge, organize the interrelation of knowledge, extract from experience what is useful for you
Study of techniques for producing humates.	Abilities and practices are being developed.	Competency in knowledge enhancement and self-education
A method for obtaining humic acid from a weak mineral sediment of a sulfide swamp	Development of a new method of humic acid production	Competence to independently improve knowledge, organize the interrelation of knowledge, extract from experience what is useful for you
A method for producing humic acid from brown coal	Skills of performing laboratory work, research skills are being formed	Competence in knowledge improvement and self-study
Technique of extracting humic acid from shale	Acquisition of skills and habits	Proficiency in improving understanding and independent study

Discussion. In the course of determining the scientific and educational skills of students, on the first day of our lecture, the definition of scientific and educational skills was carried out. The result of the definition is shown (Fig.2)

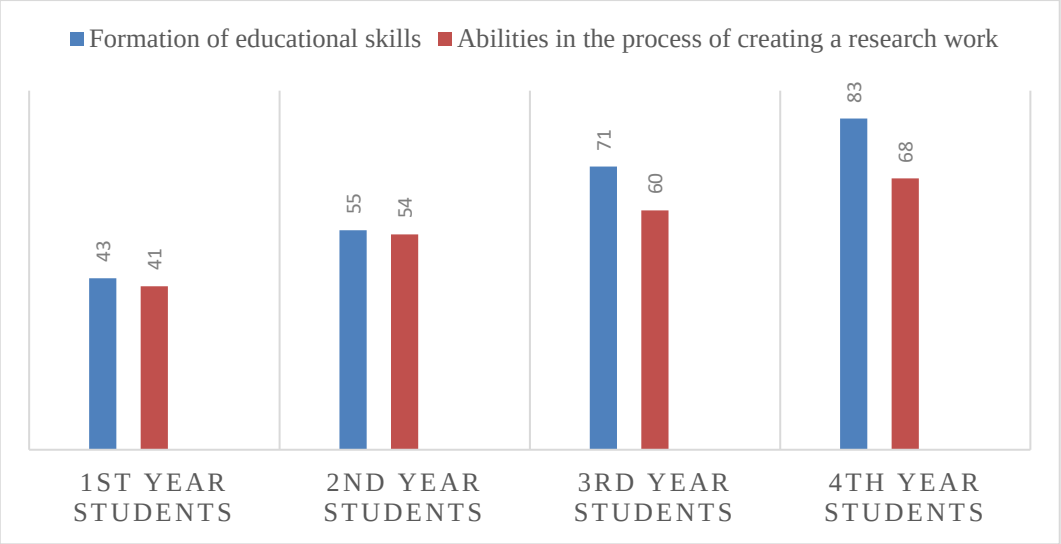

Figure 2 – Preliminary scientific research results of determining work skills

To assess the educational impact of research practice, a practical lesson was conducted on the formation of students' scientific and theoretical experience. In this regard, the disciplines in which undergraduate students conduct research in chemistry, studied in all courses, were considered. Research has been carried out on the "Levels and Methods" of classification of types of integration.

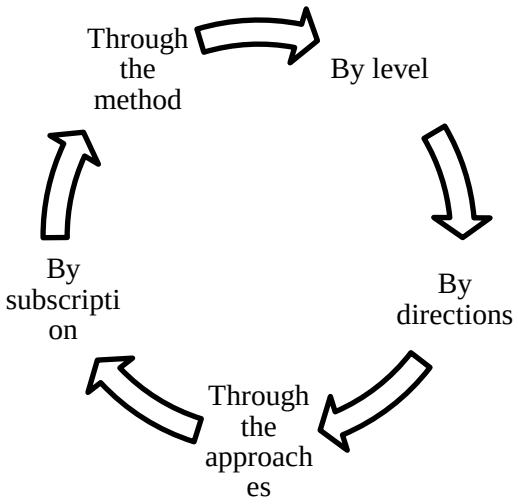

Figure 3 – Classification of types of integration

In addition to studying, students are engaged in research work, thereby forming the skills, abilities and skills of research work. To determine the level of mastering scientific research by students, practical classes were conducted for 4th year students who mastered the disciplines of "organic chemistry", "inorganic chemistry", "analytical chemistry". The study is designed for 2 hours a week, for a total of 15 hours. The practice is carried out by the methodological manual "humic acids and methods of their preparation". Methodological support for 3 lectures (6 hours), 3 laboratory practical classes (9 hours) has been developed. The requirement for students is that they be able to get a complete result from several research papers. Here is an example of one of the experiments of conducting research on the "way to obtain humic acids": *a method for obtaining humic acid from shale*

Work plan: becoming acquainted with the assignment; getting ready for the basic supplies (coal, solutions); assessment of humidity, ash content, and mineral contaminants in the coal

composition; methods for determining the yield of humic acids: leaching of humic acids from coal. Precipitation of humic acids. Disinfection of the formed sediment; discussion of the results; processing of the results of the work:

The necessary equipment for work: Muffle furnace, drying cabinet, desiccator, beaker, size 300-500 cm, pipettes, glass funnels,Buchner funnel, chemical flasks, Bunsen flask, measuring flasks, 100, 250, 1000 cm, porcelain crucibles,plates, ash-free filters, vacuum pump, analytical scales.

Equipment requiring preparation for the method of obtaining humic acid from shale.

20 g of shale; solution of 25.4 ml H HNO _ _3; 5% NaOH solution

Progress of the work:

Day 1. Measure 20 g of slate, measure 125.4 ml of H HNO _ _3 and 74.5 ml of water and place in a 500 ml glass. Leave for 3 hours in an electric stirrer for 24 hours.37 ml (H2O) + 63 ml (HNO3) = 100 ml 8 m (HNO3). Mix the slate 20g + 100ml 8m (HNO3) and place it in a magnetic mixer t =800C for 3 hours 1615-1915. after 3 hours, we take it and leave it covered for 24 hours.

Day 2. The extract is filtered through filter paper, and the remaining residue is washed with water and filtered.

Day 3. We measure out the filtered liquid.

Table 3. The results of the study of the ascertaining experiment

What level are you at in this survey	The originally specified result				The last result received			
	1st year	2nd year	3rd year	4th year	1st year	2nd year	3rd year	4th year
Education skills	43%	55%	71%	83%	54%	59%	77%	87%
Theoretical knowledge	45%	58%	67%	71%	51%	64%	71%	79%
Level of education in laboratory work	43%	51%	59%	68%	56%	59%	68%	77%
Ability to perform laboratory work	41%	54%	60%	68%	49%	62%	69%	74%
Possibility of using chemical reagents when performing laboratory work	37%	49%	56%	73%	45%	59%	65%	79%

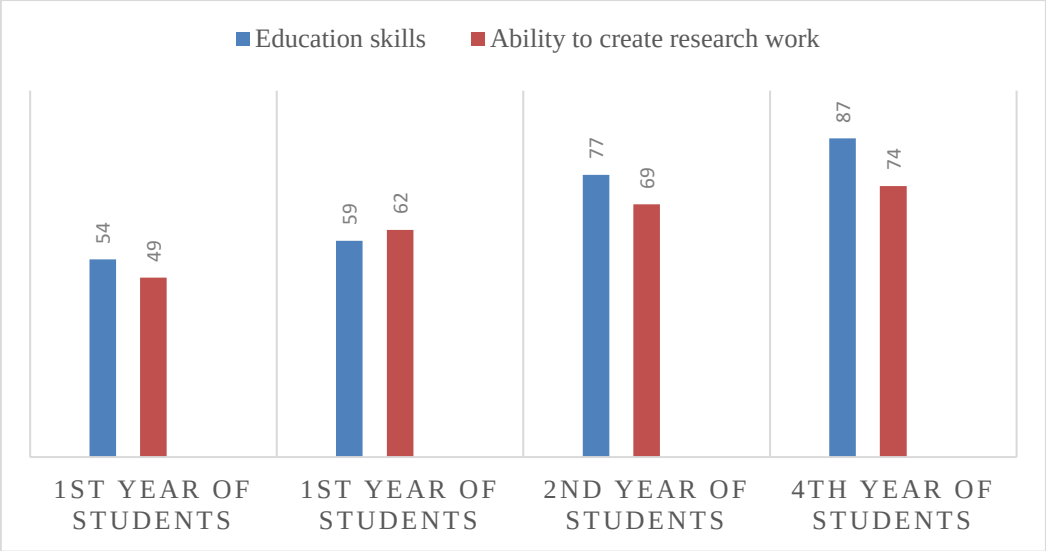

Figure 4 – Results of students ' performance after research work

According to the indicated initial results, the level of knowledge in laboratory work was 49%, the ability to perform laboratory work was 74%, the formation of chemical knowledge skills and knowledge of technology was 54-87% (good).

This understanding and ability prepare future educators to perform autonomous academic and instructional studies using contemporary techniques. In our viewpoint, it is essential to include the subject of study in the educational system for hands-on experience in the form of research projects (learning fundamental investigation capabilities) and professional (pedagogical) application of conducting studies.

Conclusion. In conclusion, it was possible to form a conceptual understanding of the knowledge gained by students about the method of obtaining humic acid from brown coal for the development of research integration. The research work carried out in the laboratory, equipped with modern special equipment, contributed to the preparation of students at a high level based on the curriculum. The course work carried out with the aim of developing students' research competence contributes to the development of students' activities, the formation of explanations of arguments.Thus, the results of the study show that students have a higher level compared to primary education. The productiveness of deliberate growth in research operations in a pedagogical institution as a component of the merger between learning and scientific research:

- first, characterize the techniques of changeover to the evaluation of potential teachers' ability;
- secondly, to intensify the implementation by students of the results of their research in the educational process;
- thirdly, the introduction of modern education

Looking at the topics and tasks listed in the table above, we can see the development of integration of education and science at the same level. When each lecture is held, we see that the next lesson is focused on laboratory work, students can engage in educational and research work. Although the University has focused on natural sciences, as well as on studying all disciplines, students who choose chemistry will undoubtedly achieve better results as future specialists.

It is known that the first integrations are carried out in chemistry lessons, when performing laboratory work, performing calculations and compiling a report on the work done among students. Studying courses of study, engaging in chemical circles, performing studies, producing publications and convention accounts, and evaluating and summarizing the results are all steps toward science.

So, nowadays, within the confines of the institution, a learner improves abilities in research by integrating education and science.

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