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IMPROVEMENT OF PROFESSIONAL TRAINING OF TECHNICAL SPECIALISTS ACCORDING TO REQUIREMENTS OF INTEGRATION METHODOLOGICAL APPROACH

Abstract. *The relevance of the research problem lies in the fact that at the present stage of development of society, integration is a necessary condition for the modernization of the content of education, since it contributes to the formation of an integral system of knowledge, the development of the thinking of future specialists, their creative capabilities.*

The purpose of the article was to substantiate the essence of the integrative approach in the process of professional training of specialists in technical specialties and to develop possible ways of its implementation in the educational process.

Based on the analyzed scientific publications and their own pedagogical experience, it has been proposed ways for implementing interdisciplinary integration in the process of studying labor protection and professional disciplines by future specialists in technical specialties. It has been determined conditions and stages of this process. It has been characterized the principles of the implementation of the interdisciplinary integration of professional and labor protection disciplines, such as: the correspondence of the educational process to the general laws of education; systematic and consistent; unity of educational, upbringing and developmental functions of education; activity and optimization of the educational process.

Further study requires certain aspects of finding effective ways of integrative methodology in modern technical education, in particular, the creation of integrative training courses that combine the humanities and natural sciences in terms of both content and theoretical and methodological aspects.

Key words: *higher educational institutions, improvement of professional training, development of education, technical specialties, interactivity, methodology.*

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УДОСКОНАЛЕННЯ ПРОФЕСІЙНОЇ ПІДГОТОВКИ ТЕХНІЧНИХ ФАХІВЦІВ НА ВИМОГИ ІНТЕГРАЛЬНОГО МЕТОДОЛОГІЧНОГО ПІДХОДУ

Анотація. *У статті поняття інтеграції визначено авторами як необхідна умова модернізації змісту освіти, оскільки воно сприяє формуванню цілісної системи знань, розвитку мислення та творчих*

можливостей майбутніх фахівців. Обґрунтовано сутність інтегративного підходу в процесі професійної підготовки майбутніх фахівців технічних спеціальностей та розроблення можливих шляхів його реалізації в сучасних освітніх умовах.

На основі аналізу представлених наукових публікацій та особистого педагогічного досвіду авторів запропоновано шляхи реалізації міжпредметної інтеграції у процесі вивчення працеохоронних та професійних дисциплін майбутніми фахівцями технічних спеціальностей, визначено умови та етапи означеного процесу. Схарактеризовано засади реалізації міжпредметної інтеграції професійних та працеохоронних дисциплін: відповідності освітнього процесу загальним закономірностям навчання; систематичності та послідовності; єдності освітньої, виховної та розвиваючої функцій навчання; активності та оптимізації навчального процесу.

Наголошено, що в результаті застосування інтегрованого підходу можливо ефективно формувати інтегровану фахову компетентність, зміст якої визначено у стандартах вищої освіти України. Окреслено ключові компетентності особистості (соціальні, полікультурні, комунікативні, інформаційні тощо) як результат інтеграції її знань, умінь та навичок у процесі опанування різних дисциплін, доведено, що впровадження міжпредметної інтеграції робить цей процес узгодженим та цілеспрямованим. Наголошено, що пошук ефективних шляхів інтегративної методології у сучасній технічній освіті, зокрема створення інтеграційних навчальних курсів, які поєднують гуманітарні та природничі науки в площині як змістовного, так і теоретико-методологічного аспектів, суттєво впливають на професійну підготовку майбутніх фахівців.

Ключові слова: *заклади вищої освіти, удосконалення професійної підготовки, розвиток освіти, технічні спеціальності, інтегративність, методологія.*

Introduction. The urgency of updating higher technical education is due to accelerated technical progress, resulting in the enrichment of pedagogical science with new knowledge, and research methods and the introduction of didactic innovations in the system of vocational education. The introduction of new state standards contributes to the fact that higher education is gradually moving away from the monopoly of software content. The application of the principle of the variability of programs in professional and general disciplines stimulates research thought and encourages creative search.

The relevance of the initiated research is determined by the presence of contradictions between:

the constant growth of the amount of knowledge that needs to be mastered by specialists in technical specialties and a significant gap in the field of higher education;

the need of practice in teachers who are competent in different fields of knowledge and the differentiated nature of the assimilation of program material;

the need to form a new status of a specialist capable of modeling technological processes taking into account uncertain conditions and the lack of a systematic approach to the formation of professional competence.

The outlined contradictions can be partially eliminated by taking into account the requirements of the integrative methodological approach in the process of improving the professional training of future specialists in technical specialties.

Analysis of scientific research and publications. The effectiveness of interdisciplinary integration in the training of future professionals is confirmed by many publications. In particular, the problem of integrated training of future specialists in free economic education is considered in the works of many scientists, for example, some aspects of integrated training of modern specialists are covered in the works of V. Bezpalko, S. Goncharenko, V. Ilchenko, M. Ivanchuk, A. Kolomiets, I. Kozlovskaya, N. Moiseyuk, V. Palamarchuk, V. Ponomareva, Y. Zhidetsky, I. Zvereva, I. Zyazyuna, etc. Scholars are unanimous in their opinion that the advantages of interdisciplinary integration, which determine the need for its use in the training process are: the formation of the ability to have a diverse vision of the problem, by considering it from different points of view; mastering an integrated approach to the analysis of professional situations; development of systems thinking skills; developing the ability to see and analyze the relationships of various aspects of professional activity.

The main directions of interdisciplinary integration in education were developed in the second half of the XX century. Methods, means, and methodical bases of coordinated teaching of different disciplines were developed. The presence of positive influence of interdisciplinary connections on the formation of knowledge, abilities, and also activization of educational and cognitive activity of pupils was investigated and established. Many publications have confirmed the positive impact of interdisciplinary links on the formation of an objective worldview of the surrounding reality in future employees, etc. (Білик, 2014, с. 246). However, the need to upgrade higher education creates new challenges for the use of interdisciplinary integration.

The purpose of the article is to substantiate the essence of the integrative approach in the process of professional training of specialists in technical specialties and to develop possible ways to implement it in the educational process.

Presentation of the main research material. Today there is a rapid increase in the amount of knowledge that must be acquired by future professionals in the process of training. This is due to the rethinking of the role of the methodological basis for the organization of the educational process. About the organization of training in institution of higher education (IHE), the methodology is understood as a set of principles, tools, methods, and forms of scientific knowledge that allow providing the expected result of the researcher, the development of a certain property or quality of the future employee (Зайченко, 2016, с. 45). A similar view is held by the Polish scientist W. Okon, who argues that methodology is the methods and means by which the study of a particular object of the surrounding reality (Okoń, 2004, с. 76).

At the same time, D. Barlex argues that the meaning of the concept of «methodological approaches» can not be defined unambiguously, because different philosophical positions lead to different definitions (Barlex, 2015, p. 146). Choice of methodological approaches to building the process of training should be guided by interdisciplinary goals, the ability to design it with the desired qualities, and take into account the relationship between society, technology, and the environment (Williams, 2017, p. 139). According to R. Vanderlind and J. Braak, taking into account the existing

gap between the training of specialists in technical specialties and the requirements of the labor market to them, there is a need to update the system of higher technical education by outlined methodological approaches. Only taking into consideration modern methodological concepts, scientists say, will provide quality education for future workers in technical fields (Vanderlinde, van Braak, 2013, p. 301).

Some foreign scholars argue that in the process of scientific research, the researcher must first choose methodological approaches, based on the characteristics of their pedagogical research, goals, and objectives. Despite the differences in the interpretation of the concepts of «methodology» and «methodological approaches», the author must define his vision of these terms and, based on this, justify the conditions and features of each methodological approach in their research (Luft, Roehrig, 2007; Olafson, Schraw, Vander Veldt, 2010).

However, M. Daniels and A. Perce emphasize that within technical education the methodology should be uniform. Therefore, it is important to jointly discuss the theoretical basis and develop methodological approaches for updating technical education. It is advisable to find common methodological principles, which should be based on further research and outline a set of variable parameters that are selected by the justifications of the researcher (Daniels, Pears, 2012).

Let us find out what methodological approaches are used by scientists in the study of the process of training specialists in technical specialties *(Table)*.

According to the results of the analysis of scientific research regarding the peculiarities of training students of technical education, it is seen that currently, the basic methodological approaches in the training of technical specialists are systemic, activity, competence, and personality-oriented. Other approaches are determined depending on the object of study and the specifics of the pedagogical experiment. The authors consider it expedient to supplement the existing list with an integrative methodological approach.

The authors of the paper agree with the opinion of I. Kozlovskaya that the system knowledge necessary for the formation of a holistic, problem thinking of a modern specialist can be obtained only based on an integrated approach to the study of professional disciplines (Козловська, 2001, с. 51).

The phrase «integration of learning» in the Short Terminology Dictionary of Pedagogy is interpreted as the selection and integration of educational material from different subjects to holistically, systematically, and comprehensively study important cross-cutting topics (thematic integration); it is the creation of integrated content of education – subjects that would unite in a single whole knowledge from different fields (Короткий термінологічний словник, 2004, с. 16).

Table

Methodological approaches in research of the process of training specialists in technical specialties

№	Author	Direction of the research	Methodological approaches
1	Martseva L.	professional training of junior specialists in radio engineering	systemic, personal-activity, competence, integrative, synergetic, resource, axiological, procedural (Марцева, 2015, с. 68)
2	Mikhnenko G.	formation of intellectual mobility of future engineers	systemic, environmental, personality-oriented, activity, integrative (Міхненко, 2016, с. 104)
3	Korsun Y.	formation of professional self-awareness of future engineers	activity, systemic, personal, dialogical, axiological, competence, contextual, synergetic, reflexive (Корсун, 2019, с. 123)
4	Stadniychuk I.	formation of technical competence of mechanical technicians	competence, activity, personality-oriented, systemic, complex (Стаднійчук, 2017, с. 84)
5	Kolodiychuk L.	designing the educational process of training electrical professionals	system, complex, activity, terminological, informational, modeling (Колодійчук, 2019, с. 42)
6	Dotsenko N.	training of future specialists in engineering specialties in the information and educational environment	synergetic, integration, activity, competence, technological, system (Доценко, 2017, с. 299).

Turning the opinion of foreign scholars shows that some of them characterize the concept of interdisciplinary integration as the application of knowledge, principles, and/or values in the process of studying more than one discipline at a time. Such a connection can be reali zed through a central theme, question, problem, process, or practical task (Jacobs, 1989). In their publications, J. Lenore and A. Hasni outlined the principles and ways of implementing interdisciplinary integration in secondary education (Lenoir, Hasni, 2016). D. Perkins believes that interdisciplinary integration allows teaching future professionals to think and discuss, as well as provides their motivation to study certain disciplines (Perkins, 1991).

Some experts argue that integration should be broader and starting with interdisciplinary integration, end with a certain integration of free economic zones and enterprises. For example, R. Gorbatyuk and N. Volkova claim that young professionals are completely unprepared for professional activity, mainly due to a lack of practical experience. Accordingly, integration at the level of IHE-enterprise will allow:

− to minimize the time of adaptation of the graduate of the institutions of higher education in the workplace;

− to involve students, and in the future young professionals, in the development of fundamentally new technologies;

− respond on time to innovations in the industry and, accordingly, form proposals to improve the content and process of training future professionals;

− to introduce an independent assessment of the quality of training (Горбатюк, Волкова, 2018, с. 90–91).

Given the different approaches in the interpretation of interdisciplinary integration, in our study, we follow the approach of V. Bevz that interdisciplinary integration is realized by «…construction of the content of educational material belonging to two or more subjects and reflects the

relationships that act effectively in nature and are studied by modern sciences» (Бевз, 2003, с. 6).

The process of professional training of future specialists in technical specialties should be implemented as a process of synthesis of general scientific and technical-technological knowledge by developing skills to comprehensively use this knowledge in solving professional problems. At the same time, the student must master the skills of safe work both for himself and for those around him.

According to G. Raikovska, the need for a comprehensive approach to the training of future specialists in technical specialties is that we must take into account the following modern features:

− the mass transition of enterprises to new technologies sets requirements for the qualification of engineering and technical personnel, namely: the ability to perceive and process a variety of scientific and technical information; master the art of managing new technologies;

− engineering and technical specialists must be ready to work at the level of international requirements;

− providing the staff of the enterprise with a development that would correspond to the profile of its activities and the current level of development of science and technology (Райковська, 2019, с. 112).

Authors agree with the statement of E. Zhelibo, N. Zaverukha, V. Zatsarny that human security problems cannot be studied separately from environmental, economic, technological, social, organizational, and other components of the system to which they belong. Each of these elements affects the other, and they are all in a complex interdependence (Желібо, Заверуха, Зацарний, 2011, с. 107).

Analysis of the problem of interdisciplinary integration showed that it can be implemented at three levels:

− interdisciplinary links, which means the existence of a certain level of relationship between the phenomena studied, and the common goals of learning, ie at this level it is possible to combine any discipline, as the emphasis is on the competence approach;

− didactic synthesis, the essence of which is to combine forms of education;

− integrity, for which complete substantive and procedural unity is necessary.

Which means the coincidence of goals and the content, principles, methods and means of education. At this level, we can talk about the creation of a new discipline (Зайченко, 2016).

We agree with the opinion of I. Sokol that a gradual transition in the implementation of interdisciplinary integration from simpler to more complex level is possible provided the strengthening of methodological activity of teachers, as well as the independence of students in training (Сокол, 2011).

For example, consider the implementation of interdisciplinary integrations in the process of studying occupational safety and professional disciplines. To ensure the possibility of interdisciplinary integration in the process of training future specialists in technical specialties, taking into account the results of the survey, a series of methodological seminars were organized for teachers, which considered its features.

To ensure the interdisciplinary integration of the disciplines «Life Safety», «Fundamentals of Occupational Safety» and «Occupational Safety» and professional disciplines, we selected such educational material that strengthened the foundation of general scientific training and was necessary for successful mastering the future profession.

According to the results of this work, the following areas of implementation of interdisciplinary integration were outlined:

− ensuring unity in the interpretation of general concepts, laws and theories, and mathematical models in professional disciplines and occupational safety disciplines;

− awareness of the unity of research methods of production activities;

− positioning of professional and occupational knowledge as necessary elements of professional development and the basis for further professional growth.

We have identified ways to ensure interdisciplinary integration of occupational safety and professional disciplines, depending on the levels of student achievement *(Fig.)*.

It is worth noting that there is still insufficient coordination between the programs of labor and professional disciplines in the training of future specialists in technical specialties. As a rule, the interdisciplinary connection between them is limited to the analysis of individual examples from future professional activities. To eliminate this problem, we have created guidelines for the development of an educational and methodological complex of the discipline for the training of future specialists in mechanical engineering (Дембіцька, Кобилянський, 2020). This allowed us to identify the main ways of interdisciplinary integration and implement them in the process of training future specialists in technical specialties.

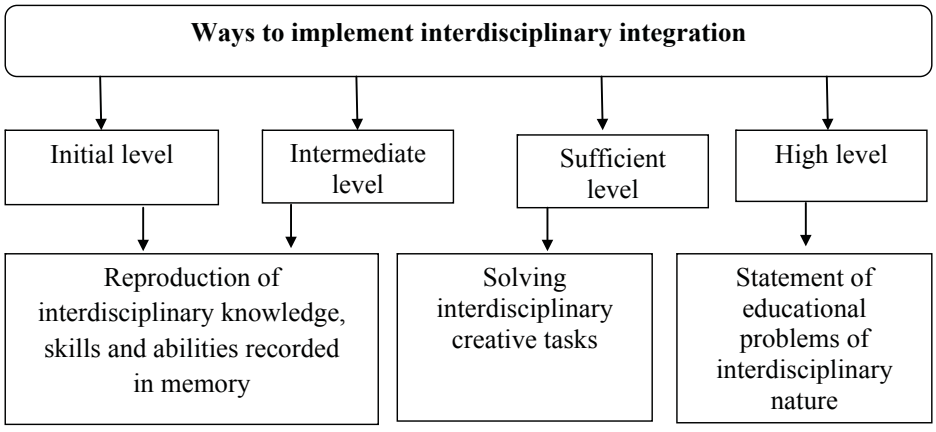

Fig. Ways to ensure interdisciplinary integration of labor and professional disciplines

This process took place in the following stages:

1. Analysis of work plans for training in the relevant field of knowledge and the selection of basic disciplines with which the establishment of interdisciplinary integration will be most effective.

2. Coordination with teachers of certain disciplines on possible ways of interdisciplinary integration, topics, and issues in which issues of life safety and labor protection can be considered.

3. Development of methodological recommendations for the implementation of interdisciplinary integration.

4. Making changes in the work programs of professional disciplines.

5. Study the level of educational and cognitive activity during interdisciplinary integration and motivation to study the disciplines «Life Safety», «Fundamentals of labor protection» and «Labor protection in the field».

The use of interdisciplinary integration should be organically linked to the use of information technology in the training of future professionals. After all, they are the very tool that allows you to most effectively implement interdisciplinary integration and optimize the learning process.

As evidenced by the analysis of scientific publications and their own pedagogical experience (Дембіцька, Кобилянський, Горохівська, Пугач, 2021; Дембіцька, Мястковська, 2021), due to the use of information technology in the training of future specialists in technical specialties there is an opportunity to effectively develop research skills, in particular: to hypothesize, make a plan for the task, determine the stages of achieving the goal. Working with Internet resources involves performing the steps inherent in research: outlining the problem, defining goals and objectives, searching, summarizing, and systematizing the necessary information, comparing, analyzing, and describing the data, as well as their graphical interpretation. This creates the conditions for the formation of future research skills: to see the problem, formulate the purpose and objectives of the study, search and process information, determine the essential characteristics of phenomena and processes, analyze results, and design them in tables, graphs, charts.

However, the formation of these skills is not spontaneous, to coordinate this process, it is necessary to properly organize the work of students. The following features of modern student youth should be taken into account: the desire to combine personal interests with the interests of society, taking into account the trends of the latter; the ability to quickly adapt to new requirements and living conditions, as well as the desire to influence and change these conditions to achieve this goal; computer literacy, which is manifested in the rapid orientation among information flows, the availability of skills in working with information resources; ability to initiate and maintain contacts with distant and strangers.

In addition, this process must be systematic and consistent. The introduction of interdisciplinary integration into the system of professional training of future specialists will be effectively provided it is used systematically and comprehensively.

During the study of occupational safety disciplines, the following tasks are announced:

1) acquaintance with the main types of Internet resources that can be used in preparation for classes on life safety and labor protection;

2) formation of experience of search and selection of Internet resources following the defined purpose of the educational task;

3) formation of skills in using databases of normative and legislative documents, the establishment of their status and scope;

4) acquisition of skills to analyze foreign regulations, clarify their status and scope, and compare them with similar domestic regulations;

5) development of a system for evaluating the effectiveness of Internet resources and methods of verifying the accuracy of the information found;

6) actualization of the need to independently master new Internet sources to improve the quality of their professional training and self-educational activities.

It should be borne in mind that the use of any innovations in the training of specialists in technical specialties in terms of content and features of use in the educational process must comply with established didactic principles.

In the initiated research, we focus on the application of the system of didactic principles for the use of information technology training in higher education (Стрельніков, Брітченко, 2013). The educational technologies used must meet the basic principles of building and mastering the system of scientific and professional knowledge, provide a creative, personality-oriented orientation of the training process, and promote the democratization of the educational process and interaction of all participants in the context of the competence approach in higher education.

We characterize them, taking into account the features and principles of interdisciplinary integration of professional and occupational safety disciplines.

1. The principle of conformity of the educational process to the general laws of learning requires organizing the educational and cognitive activities of students in the process of vocational training using information technology to be able to establish stable and appropriate relationships between teaching, learning, and educational content while implementing interdisciplinary integration and professional disciplines.

Adherence to this principle means that the teacher must ensure the conduct of the didactic process following the laws of learning and thus achieve certain learning objectives. The main content of the laws of education is the gradual mastery of students' scientific content of the discipline, so the purpose of learning using interdisciplinary integration of professional and occupational safety disciplines should be achieved in stages, by solving some partial didactic tasks.

The study of occupational safety disciplines in the institutions of higher education involves the formation of critical and risk-oriented thinking, which consists of the ability to identify the genesis of a phenomenon, tracing all stages of its development, causes, patterns, and more. The pedagogical aspect of the formation of critical thinking is to clarify the conditions and construct ways and means of developing students' thinking in the educational process. In our opinion, working with primary sources posted on the Internet (with archival materials, and legislation) contributes to the implementation of this principle.

2. The principle of systematicity and consistency involves the disclosure of cause-and-effect relationships of phenomena, processes, and events, the inclusion in the teaching aids of scientifically proven knowledge that corresponds to the current level of development of science. During the implementation of interdisciplinary integration of professional and occupational safety disciplines to comply with this principle, we organized the activities of students according to the following scheme:

1) in the first stage – students get an idea of the theoretical content of the topic as a whole;

2) intermediate stages – the study of individual parts of the content of each educational issue;

3) the final stage – the disclosure of causal links between the individual parts of the topic and bringing the level of content of educational material to the required level of mastery.

For example, when studying the topic «Means of individual and collective protection», students first develop general information on this topic (classification, advantages, and disadvantages, conditions of use, etc.), and then, use photos and videos available on the Internet, study their structure and principles of use, outline possible situations in professional activities where their use is necessary.

3. The principle of unity of education, upbringing, and developmental functions of education provides for the implementation of interdisciplinary integration of professional and occupational safety disciplines when education performs not only educational but also educational and developmental functions.

For example, working with a computer lab workshop developed and used at the Department of Life Safety and Safety Pedagogy of Vinnytsia National Technical University on Life Safety and Occupational Safety provides an opportunity to simulate dangerous phenomena and processes that future professionals may encounter in everyday life and at work. places (accidents with leakage of highly toxic substances, nuclear explosion, volcanic eruption), which contributes to the intensification of educational and cognitive activities, provides an opportunity to imagine the real consequences of this situation, develops the habit of making and explaining decisions and actions reasoned, accurate calculation. In the «training» mode, the student has the right to make a mistake, which in real conditions will not be dangerous. In addition, the university has the opportunity to see the real consequences of the decision and imagine how large they are. A person who has thus «visited» dangerous situations will act more prudently and correctly in real conditions.

In addition, this organization of work makes it possible to take into account the individual psycho-physiological characteristics and pace of work of each student. After all, due to lack of time and differences in the perception of new information, not all students have time to complete the task and go through all stages of research. Therefore, we formulate the tasks for laboratory work in such a way that students in case of lack of time in the classroom could finish work at home, using the instructions.

At the same time, the future specialist directs his activities, focusing on the received guidelines, chooses a comfortable pace and time of execution, has the opportunity to show their creativity, and performs most of the stages characteristic of this study.

The relevance and expediency of this approach are because in the conditions of free economic education following the requirements of the Bologna Process, the emphasis is on individualization of learning and building an individual educational trajectory for the student. Therefore, scientific and methodological publications draw attention to the need for individualization of education in the institutions of higher education and increased attention to it in the context of modern requirements for the training of future specialists in technical specialties.

4. The principle of student activity reflects the relationship between the success of educational and cognitive activities and the formation of interest in it. He points to the need for the formation of positive motivation, and continuous motivation to master the content of learning. Adherence to this principle is one of the most important conditions for the effective implementation of interdisciplinary integration in the training of future specialists in technical specialties.

To comply with the principle of student activity in the process of professional training, we use research and creative interdisciplinary projects that motivate the study of occupational safety disciplines. For example, when studying the topic «Man-made hazards» we offer students to assess the consequences of a man-made accident or disaster and develop a plan of action to eliminate it. Students search for information about the accident (statistics, videos, causes of the accident) on the Internet. The results of students' creative work are demonstrated in the form of presentations at a meeting of the Student Scientific Society or in the form of speeches at student scientific conferences.

5. The principle of optimization of the educational process (improvement of methods and ways of educational and cognitive activities based on the comparison of different forms, methods, and teaching aids depending on their tasks and content) in the process of interdisciplinary integration of labor and professional disciplines involves gaining creative experience. The essence of this principle is that gaining experience is impossible without the involvement of the subject in the solution of a specially designed system of creative and problematic tasks.

The latter allows you to create problem situations that require the student to be creative at a level accessible to him. This principle implies that the teacher in the design of interdisciplinary tasks must initiate a problem situation and thus intensify educational and cognitive activities. Giving it the features of creative, exploratory activities.

Conclusion. Thus, the need to use interdisciplinary integration in the process of training specialists in technical specialties is that it is a reflection of those integration processes that occur in science and industry.

An integrated approach to teaching disciplines, common methods, and tools used in interdisciplinary integration create opportunities for future professionals to learn to comprehensively solve problems and apply acquired knowledge, skills, abilities, and competencies in future production and research activities.

At the same time, as a result of the integrated approach, we have the opportunity to effectively form an integrated professional competence, the content of which is specified in the standards of higher education in Ukraine. In addition, it should be noted that all key human competencies

(social, multicultural, communicative, informational, etc.) are the result of integrating knowledge, skills, and abilities in the process of mastering different disciplines, and the introduction of interdisciplinary integration makes this process coherent and focused.

Prospects for further research are to identify ways to implement the integrative methodology in modern technical education, including the creation of integrative training courses that would combine the humanities and sciences in terms of both content and theoretical and methodological aspects.

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