

# Design of Educational Programs within the Framework of the Competence Approach

Principles, problems, main stages of work, exchange of experience

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**Abstract**—The experience of designing the educational process at a technical university based on the competence-based approach is studied. The design principles are highlighted, recommendations on the design of the educational process are summarized, the methodology of the development of the main educational program is presented. The analysis of the design stages is given and results of training on the introduction of the integral discipline "Project activity" are demonstrated.

**Keywords**—competencies, higher school, pedagogical design, state educational standard, basic educational program

## I INTRODUCTION

The competence approach, actively developed in the system of higher education, has affected many countries. This approach has expanded professional opportunities and the labor market of specialists. Graduates of European educational institutions actually receive the status of real specialists only as a result of practical activities at their places of work and after high appraisal of their professionalism in attestation tests in professional societies. Professional societies in collaboration with industrial companies also give a professional assessment of curricula developed by universities, adjust their programs for newly admitted students, and prepare new programs for updating knowledge and raising qualifications [1]. It includes representatives of engineering universities, production workers, employers, and people representing the economic sector of the industry. With such a system of work, students form the right attitude towards studying at the university [2]. For example, in the UK, such regulatory body of requirements is the Engineering Council (Engineering Council of the United Kind, ECUK). They include representatives of engineering universities, manufactures, employers, and people representing the economic sector of the industry. A similar system is developed at Novosibirsk State Technical University (NSTU). This university is a flagship one and is a leader in the country, it has a unique practice of training engineers who are much-in-demand in Russia and abroad. For many years, the university has been a branch of the Research Center for Quality Problems of Specialists Training, which is engaged in fundamental and applied research in the field of teachers' work quality and the quality of educational process. The results of this work have set a new vector in the development of the education system in

Russia. Long-term experience in designing the main educational program based on the competence-based approach, implemented during administration, teachers and staff of higher educational institutions training is generalized. The stages of development, recommendations and algorithms of pedagogical design of the main educational program on the basis of the competence approach are presented.

In Russia, the Federal Service for Education and Science Supervision (Rosobrnadzor) is the leading regulatory structure for the quality of training in higher education. Rosobrnadzor determines external requirements in areas of training bachelors, specialists and graduates in the form of the Federal state educational standard (FSES). The Federal State Educational Standard of Higher Education (FSES HE) is a set of requirements that are mandatory for the implementation of basic educational programs of higher education by educational institutions that have state accreditation. Rosobrnadzor supervises the activities of universities concerning its implementation, and provides the right to license activities. For each area of training in the FSES, general cultural (universal), general professional and professional competences are presented. Their content and completeness are determined by the university. According to external experts, employers and scientific community, this list of competencies is sometimes narrowed; the content needs to be rethought, because it is not clearly understood by the participants in the educational process. The presented wordings of the competences in view of the high degree of their generality do not sufficiently reflect the practical activities of the graduate, which complicates their diagnostics. The difficulties and contradictions arising in the process of the educational process design on the basis of the competence-based approach are analysed, and options for solving them are suggested.

## II PRINCIPLES OF PEDAGOGICAL DESIGN

The process of developing any educational systems is impossible without following certain rules. These rules are the principles of pedagogical design; they form the conceptual basis of the process. Pedagogical design is defined as an integrated and cyclical process of developing a "concise", concentrated image of an educational program or academic discipline, based on both theoretical and practical achievements

of pedagogical science. It is based on historically established traditions, on new goals, values, development trends and requirements of the educational system as well as modern computer technology.

The leading principles of pedagogical design are:

- Consistency (following the basic requirements of a systems approach).
- Synergism (the cumulative effect from the use of individual factors is higher than from their independent use).
- Invariance (definition of common conceptual approaches for various classes of projected objects).
- Variability (taking into account the characteristics of specific objects and situations).
- Personality-activity (focuses on the organization of such activities of students, in the course of which they master productive ways of system activity and system thinking).
- The principle of human priorities as a principle of orientation to the person (takes into account the needs, values, features of the participants in the educational process).
- Continuity (organization of structured step-by-step design process and consideration of the interrelation of design stages).
- Self-development of the designed systems (it means making them dynamic, flexible, capable of implementing changes, restructuring, complication or simplification during implementation).

### III RELEVANCE OF DEVELOPING A PASSPORT OF COMPETENCE FOR THE UNIVERSITY

Ensuring systemic consistency between requirements for the results of educational programs (EP) development and content of education, providing the achievement of these requirements is among the leading tasks in the design of competence-oriented university (EP) [3]. The system of regulatory documents developed was by the university. One of them is the passport of competence.

A competence passport is a valid set of university requirements for the level of competence formed at the end of mastering the basic educational program (BEP).

The (BEP) of higher education is a set of educational and methodological documentation, including the syllabus, the curriculum of training courses, subjects, disciplines (modules) and other materials that ensure the development and quality of training students, as well as curriculum and production practice programs, a calendar study schedule and methodological materials to ensure the implementation of appropriate educational technology.

The requirements of the Federal State Educational Standards of Higher Education Establishments do not set the

requirements for the mandatory minimum of educational content, but for the results of mastering the EP expressed in the language of competences. Thus, the emphasis has been shifted during the design of the EP from the educational content (input parameters of the EP) to learning outcomes and competencies (output parameters of the EP). However, working with competencies as the basis for designing EP requires an unambiguous understanding: what composition of learning outcomes (to know, be able to master) should be achieved and why [3].

#### A. *The main objectives of the development of a passport of a competence*

Providing a university has unambiguous requirements for the relevant learning outcomes: what kind of learning outcomes must a student demonstrate as part of the final state attestation measures in order to confirm that he has formed the competence of a given level? The problem is as following: FSES HE contains requirements for the results of mastering the EP in terms of competencies, the wording of which is to a certain extent broad, frame-based. This is due to the fact that the requirements of the FSESs reflect the requirements for the quality of training at the national level and must be met by all universities in the country. At the university level, the specification of federal requirements is required, taking into account regional and university specifics: the wording of competencies is specified in accordance with the training profile (for undergraduate education) or the name of the program (for magistracy). Also, the university establishes threshold levels of competency formation, the achievement of which is a mandatory minimum for all graduates of this EP. With such specification for the same competence, a situation of ambiguous interpretation of the content of relevant knowledge, skills and experience of the activity by different teachers may arise. The vision of employers - strategic partners - also requires coordination. In this situation, the passport of competence acts as a tool for reducing uncertainty, reaching a compromise between teachers, university administration and employers.

If the university decides on the need to refine the content and wording of the competencies represented in the FSES HE in the direction, then it is in the passport of competencies where information can be provided on the additions made:

- 1) *On clarifying the wording of competencies for a specific training profile.*
- 2) *On clarifying / simplifying the wording of competence to increase its unambiguous interpretation by teachers.*
- 3) *On combining several homogeneous competencies into one.*
- 4) *On the structuring of complex wording competencies, the components of which involve the development of various "tools" (for example, "the ability to self-organize and self-educate").*

All documents in the EP are interrelated, but the passport has the closest connection with the competence model of the graduate, the program for the formation of competence and the program of final state certification (see Fig. 1). In this case, various software environments can be used [4,5].

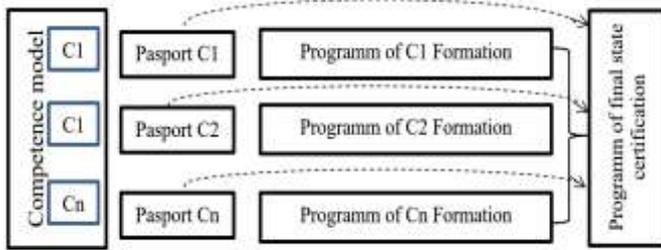


Fig.1. Relationship of the competence passport with other interdisciplinary documents

The competence model of a university graduate in the direction of training (specialty) is a comprehensive integral image of the final result of education at the university in the direction of training (specialty). The model is a holistic structure of the list of competencies of a graduate, presented in graphical form.

The competence passport has similar characteristics with the Competence Model of the graduate, since they establish summary / definition, structure and characteristics of the compulsory (threshold) level of formation of competence.

However, there are differences in them. A competence passport is developed for each competence individually and contains more complete information about it. This makes it possible to substantiate why exactly this level of competence is set at the university as a threshold and why exactly this set of requirements is presented. The difference of the threshold level for a bachelor and a master of science student should be given in the passport of competence.

The program of competence formation is a reasonable combination of educational content, methods and conditions that ensure the formation of competence of a given level.

Competence development program accumulates information in the field: learning outcomes - learning technology - assessment methods. The program combines the answers to the following questions: what educational trajectories allow students to achieve the minimum mandatory level of competence formation? What are the stages of formation of a competence in high school? On what modules, disciplines and extracurricular activities is it formed? What do teachers and students need to do to ensure the formation of a given level of competence? What methods of assessment are recommended by the teacher for usage? What specific conditions are needed?

#### IV THE STRUCTURE OF THE PASSPORT OF COMPETENCE

1) *Definition / content and basic essential characteristics of competence.*

2) *Place and significance of competence in the cumulative expected result of education of a university graduate upon completion of the development of a competence-oriented EP in the direction of training.*

3) *Accepted competency structure.*

4) *Planned levels of formation of competence of university graduates.*

5) *The overall complexity of the formation of competence in the "average" student of the university (in hours) at the "threshold" level.*

A. *Definition / content and basic essential characteristics of competence.*

The purpose of the section is that the meaning of some competencies may require clarification:

1) *The context is too broad, requiring clarification for a specific profile,*

2) *The formulation is too complicated and for a better understanding, its simplification / reformulation is required,*

3) *The meaning of a number of competencies (or the concepts used in their formulations) may be different for different categories of users: teachers, students, employers.*

It is advisable to introduce this section. If the sense of competence is unambiguously clear, then this section can be removed from the passport of a specific competence, and the note "content of competence does not require clarification" should be added. To determine the list of competencies for which clarification of their content and main characteristics are required, the method of comparison of expert assessments can be used. The method allows you to see how respondents understand the wording and agree with it.

B. *Place and significance of competence in the cumulative expected result*

The purpose of the section is that it provides assessment of the significance of this competence according to the results of a sociological study when identifying the current composition of the competencies of a graduate with the participation of employers, the scientific community, teachers and graduates of previous years; the interrelation of this competence with other significant competencies of previous years university graduates is indicated; interconnection of the given competence with other important graduate competencies is shown [6]. Understanding the significance of individual competencies makes it easier to allocate resources when designing an educational program. Significance (importance) of competence can be used as a criterion in optimizing the curriculum.

C. *Accepted competence structure*

This section is one of the most important and time-consuming competencies in the passport for designing the educational process. This section lists the learning outcomes that a student must demonstrate in order to confirm the formation of a competence. The information presented in this section is used as a basis: for the design of individual training modules; for conjugation "competence - the content of education"; for the selection of distinctive features of the level of competence for the degree of bachelor, master, as well as for the intermediate stages of assessment.

The main task in preparing this section is to achieve an unambiguous understanding, namely, which actions are a

manifestation of this competence. The competence structure is developed on the basis of the FSES, taking into account other relevant social and sectoral norms, standards and needs in terms of ensuring graduates of the university with the demand on the labor market and willingness to learn throughout their lives. The definition of the structure of competence can have several stages (depending on the complexity of the competence). The sequence of these stages provides a contingency in the transition from competence to the results of education and, accordingly, the content of education.

#### *D. Definition Stages of Competence Structure*

*Stage 1. Auxiliary modifications:* a representation of a generalized structure of competence, providing further selection of actions uniquely demonstrated by the student. At this stage there can be three situations requiring their own course of action.

Option 1: Competence is obtained by combining several competences from the FSES. It is in this section that one can present a transformed formulation of several competencies. In this situation, individual competencies can be “collapsed” into one with a more general name. Option 2: there is a complex structure of competence, consisting of actions that require different “tools” (for example, “knows how to work in a team, lead people and obey”). Such “complex” competencies at the first stage can be divided into structural elements. Option 3: the competence is well formulated and does not require additional transformations (merging, dividing into simple parts). In this case, no additional changes are required.

##### *Stage 2. Selection of constituent actions.*

At this stage, the components of the action (parts, elements) associated with the demonstration of this competence are selected. The following organizational methods can be used to select such a set of actions (parts, elements):

*a) Expert assessment, focus groups, brainstorming (discussing actions with the participation of an expert group, and coming to a compromise solution and necessary and sufficient actions contents).*

*b) The selection of actions contents by a group of teachers whose disciplines are unequivocally aimed at the formation of this competence [7].*

3-5 disciplines in the curriculum are selected from the available disciplines for the formation of this group. They form this competence in a unique way. The main idea of the method is that this group of teachers selects the composition of the main actions (parts of the competence) and distributes them among their disciplines. Then, for each part of the competence assigned to his discipline, each teacher selects the appropriate learning outcomes (to know, be able to master) and only after that the complex learning outcomes corresponding to the competence as a whole are jointly discussed. The value of the contribution of each element in the formation of the entire competence is given, taking into account the weight of the element (the total weight of 100 is divided between all elements of the competence). When using the group of methods “a”, there is a greater likelihood of ensuring the completeness of the formed

set of actions; with the method “b”, there is more reliability in ensuring that students are prepared to demonstrate the set of actions. It is advisable to use both groups of methods [8].

When choosing actions contents, it is not always possible to assess the completeness of the obtained set of actions, since competences have an activity basis. Therefore, as a guideline, you can use the idea of the stages of activity - goal-setting, design, implementation of actions, analysis of the results of actions and comparing them with goals.

A comprehensive solution to this problem is possible only when using professional standards (PS). They are developed by leading employing organizations. This document is a kind of “external” order presented by an employer to an employee. PS is a description of the qualifications required for an employee to perform a certain type of professional activity, including the fulfilment of a certain labour function. PS is an important detailed description of a specific type of professional activity regardless of the organizations and regions of the country where it is implemented, how the staff list is formed (the division of labour is carried out) in specific organizations. PS is developed for the type of professional activity, where the presented generalized labour functions are the “model” (typical description) of the profession, position, revealing the key (main) set of labour functions that have similar character, results and working conditions. Each generalized labour function describes a professional activity that can be performed by one employee (in most organizations where this type of professional activity is implemented). In other words, the generalized labour function corresponds to the job duties (typical description of the profession, position), but is not identical to the job description in a particular organization. The generalized labour function consists of several labour functions, which are described in the form of labour actions, necessary knowledge, skills and other characteristics. The content of the PS allows you to see the image of the employee, what a potential graduate could become.

Long-term practice proves that the work on the selection of the content of the constituent actions of competencies based on professional standards is mandatory. It helps to optimize the process of selecting learning outcomes. After all, an undergraduate or graduate student in any field of training has a specific “niche” of employment in the labour market.

##### *Stage 3. Selection of learning outcomes, revealing the structure of competence.*

When selecting learning outcomes that reveal the structure of a competence, the actions contents of the competence are taken into account (so as not to “miss” any action) [9]. The learning outcomes are projected in three areas: knowledge (knowledge and understanding), activity (application of knowledge), value (attitude, values). The following approaches can be used as a basis for determining the structure of competence:

*1) Reliance on the general definition of "competence", adopted in the FSES.* According to the FSES, competence is the

ability to apply knowledge, skills and personal qualities for successful activity in a particular field. According to the FSES, the learning outcomes in cycles are systematized according to three levels of development: to know, be able to master (this approach prevails in the practice of universities).

2) *Taking into account the structure of the concept of "competence", adopted in the pan-European project "TUNING".*

According to the project "TUNING" competence includes:

- "KNOWLEDGE AND UNDERSTANDING" (knowledge of the academic field, ability to know and understand)
- "KNOWLEDGE HOW TO ACT" (practical and operational application of knowledge to a specific situation),
- "KNOWLEDGE HOW TO BE" (values that are an integral part of perception and life with others in a social context).

The learning outcomes are planned for the following groups: knowledge and understanding (group A), intellectual skills (group B), practical skills (group C), transferable skills (group D).

3) *Consideration of the components of the result of education (according to the taxonomy of B. Bloom and his followers) in three areas: cognitive (cognitive), affective (value-emotional), psychomotor.*

4) *The use of the results of domestic (including our own) and foreign scientific research on the problems of the competence approach in higher education.*

The issue of developing a competency structure is open; therefore, other approaches that differ from the above, which provide orientation on competences and learning outcomes, can be developed and used.

#### *E. Planned levels of development of competence of university graduates*

There are the following requirements for graduates: the threshold level, mandatory for all university graduate students, and advanced (one or more) levels (relative to the threshold). Advanced levels can correspond to one main feature, to several features and to all features. In this case, it is convenient to represent information in a tabular view.

The purpose of the levels of competence is to build on their basis the stages of learning gradually increasing the complexity of tasks that students are able to independently solve. This means that it is not enough for a university to describe only those levels of competencies that it intends to form among graduates [10]. It is necessary to describe all levels, starting with the one that fixes the entrance requirements for applicants. Level description is the basis for the development of test and measurement materials for final state certification.

The characteristics of the threshold level of competence formation must correspond to the characteristics of the degree

(qualification) received by students of bachelor, master and specialist programmes. To do this, Dublin descriptors (European distinguishing features), European Qualifications Framework and National Qualifications Framework are used as a reference point.

#### *F. The overall complexity of the formation of competence of a university student (in credits) at the "threshold" level*

In preparing the curriculum, the coefficient of complexity of the formation of competence can be used. It characterizes the weight of the competence in the general competence model of a graduate and is determined by the duration of its development, as well as the complexity of the disciplines involved in its formation. The value of this coefficient, based on many years of practice, is taken from the interval [0.5; 2].

Information can be presented in the following form:

1) *Projected estimates (loans).*

2) *The updated assessment obtained on the basis of specific scientific research at the university (if any).*

The forecasted assessment is determined by expertise means, and the updated one - according to the accumulation of experience in the formation of this competence.

#### **V PRODUCTIVE TECHNIQUES IN THE DEVELOPMENT OF WORK PROGRAMS DISCIPLINES.**

One of the results on the development of a passport of competence is the selection of external requirements for the content of disciplines. Each discipline is assigned a list of developed competencies in the form of relevant knowledge and skills. At the same time, the teacher-lecturer carries out the decomposition of high-level goals (competence) into objective goals. For these purposes, the content is selected, the students' educational activities are planned, and monitoring materials are prepared. At the same time, productive ways of activity can be effectively used [11].

- In the design process it is necessary to take into account that several disciplines are involved in developing the same competence in the EP. Each discipline makes its own "contribution" to the various components of competencies. The contribution of the discipline is determined by the subject objectives of the academic discipline, formulated at different levels of learning (to have an idea, know, be able to master). The development of common cultural (universal) competences is ensured in terms of the use of active forms of education. The works [12,13] presents unique materials on the use of technology problem and project training in engineering training.
- If an academic discipline belongs to the basic part (humanitarian, social and economic cycle) of the EP, then it is possible that only general cultural competences are developed in this academic discipline.

- If the discipline belongs to the basic part of the cycle (professional cycle) of the BEP, then it is necessary to select the requirements of all types: general cultural competences, professional competences and the requirements of the types “know” and “be able”.
- If an academic discipline belongs to the variable part of the EP, then it is necessary to understand that the emergence of this discipline in the curriculum is an order “from the outside”, its content is primarily aimed at the formation of specific general professional and professional competencies;
- If the same professional competencies are assigned to several academic disciplines, then the method or object studied in a particular discipline should be clarified at the goal level.
- If only professional competencies are assigned to a discipline, then general cultural competencies must also be analysed and selected, since they can and should be developed in any discipline.
- When focusing on the content and structure of the formed competencies, it is necessary to correlate their requirements with the amount of hours devoted to studying the material of the discipline and the level of students' initial training. At the undergraduate courses, the contribution of the discipline to the development of competence is often limited by the “know” level, and at the senior courses, on the contrary, it is necessary to create conditions for the development of the competence component “to be able”. The contribution to the “mastering” component of the competence must be treated very responsibly, understanding that this level of mastering the material means the ability to use the material of the discipline in new conditions. This level of achievement of students in the discipline is provided, as a rule, in the course of various types of practices and in the preparation of final qualifying work.

## VI "PROJECT ACTIVITY"

The professional competencies represented in the FSES are integral and interrelated [14]. In order to develop general professional, professional, general cultural competences the most close to a specific professional activity, various types of production practices are introduced into the curriculum. At NSTU, their number ranges from three to five. About one semester is allotted for each practice (18 academic weeks). As shown by many years of experience of teaching students these practices are not enough. Employers together with the university administration decided to introduce in all areas of training for bachelors a new discipline “Project Activities”. This discipline is studied for three semesters (from the fifth to the seventh). There are two credits per semester for this discipline. Using the example of the “Chemical Technology” preparation direction, we will reveal the content of this discipline (Table 1).

TABLE I. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE

Initial data of the competence model		Objectives of the discipline
Code and wording	Competence content	
PC.24. the ability to carry out the process in accordance with the regulations and use technical means to measure the main parameters of the technological process, the properties of raw materials and products to know the main stages of the technological process and technical means to measure its main parameters, properties of raw materials and products	know the technological process and technical means	know the main stages of the technological process and the technical means for measuring its main parameters, the properties of raw materials and products
	know the basic optimization methods and principles for the development of chemical-technological processes;	know the basic optimization methods and principles for the development of chemical-technological processes.
PC.28 the ability to carry out project activities at all stages of the project life cycle	to be able to identify the necessary resources for the implementation of project tasks;	to be able to determine the need for resources for the project and ways of obtaining them
	be able to organize and coordinate the work of project participants;	be able to develop a project plan, monitor the implementation progress, make adjustments and additions to the implementation plan
	be able to identify the problem and how to solve it in a project;	know the key categories of project activities, types of projects, stages of the life cycle and features of their implementation; be able to develop a project concept (define goals, objectives, justify relevance, determine the expected results)

Students are engaged in research and production activities in the course of project [15]. The result of the work is a new specific technical solution (product), which is promoted to the market. Training is organized on the basis of the following principles:

- The goal of project training is to develop the ability to solve problems in the face of uncertainty and to work in a team [16].
- The student is in the center of the educational process.
- The student has the opportunity to choose a project theme.
- Project training is mainly organized as a research activity.
- The final product of the project is socially significant.
- The final product of the project has a value and meaning for the student.
- Project-based learning is one of the forms of implementation of problem-based learning; the distinctive features of project-based learning are effectiveness, “scale” and practical significance.

- Description and analysis of intermediate and final results in the final project report are mandatory.
- There is availability of an analytical stage of research in the design process.
- Joint activities of students with the teacher on the project (the teacher is dominated by consulting activities at all stages of work) contribute to the success of the work.
- The student is responsible for the design decisions made.
- Criteria for assessing the quality of the final product of the project are formulated, discussed and adopted together with the students.
- Self-assessment of students' success in the course of research activities is an educational tool (in particular, SWOT analysis).

Students in the field of preparation "Chemical technology" carry out fundamental and applied research in the field of synthesis of new functional materials; model and carry out the process of processing natural gas to create carbon fiber materials, nanomaterials; produce new catalysts for the chemical industry. Students are actively engaged in contract-based or business activities. It is possible to prepare patent documents for the registration of a new product of intellectual property. Students look for potential partner-employers interested in their product. Students draw up the results of work in the form of a report with mandatory oral protection in scientific communities, at international conferences and publication of data in scientific journals. The following steps can be distinguished in the activities of students in the discipline.

1) *Trial design* (studying the problem, formulating the problem, defining the goals and objectives of the project, choosing solutions, drawing up a work plan, defining responsibilities and distributing them among the project team members, developing criteria for assessing the quality of the final product and the design process).

2) *Design - project implementation* (project planning, project implementation).

3) *The results of the project* (analysis of the results of the project and the design of the explanatory note, the presentation of the project, the promotion of the project on the market and in the scientific community).

## VII RESULTS AND DISCUSSION

The design of the educational program in the direction of preparation "Chemical technology" (bachelor degree) from the position of a competence-based approach based on the listed requirements was highly appreciated by students and employers. In the curriculum in this area, 53 disciplines are represented. They allow the student to plan his own training. Each discipline, its structure, content, activities have been completely recycled. Each discipline has the ability to organize activities as part of blended learning on its own DiSpace 2.0 platform. According to the results of the external independent expert assessment of the quality and assessment of students, the educational process and training materials in the disciplines that

are based on the abovementioned requirements have acquired a number of new characteristics:

- The student's competencies and goals (in terms of his accomplishments) are formulated, which he can achieve by working with educational materials; a number is clearly traced: competences - goals of the discipline - educational activities - controlling materials.
- The student's previous experience is taken into account, there are propaedeutic materials filling gaps in the initial level of training.
- Optimal conditions for independent work have been created, there are recommendations on the organization of work with materials; the emergence of the need to learn throughout life, the desire for professional growth and competitiveness in the labour market.
- Training materials aimed at solving the difficulties of students, provide an opportunity to receive answers to emerging questions; the activity of students is organized around the cognitive task.
- Provides a brief theoretical information, demanded to perform tasks.
- A high degree of structuredness of the material based on the principles clearly formulated by the author; forms redundancy for structuring the same information.
- The novelty of the presentation of the material, the author's position and the interest of the author are traced, the professional context of the activity, the high connection between theory and practice is evident.
- Educational information is presented on the basis of psycho-physiological characteristics of students, the same material is presented in various forms (in the form of graphics, text, tables, charts, illustrations ...); conditions are created for inclusive education.
- Different points of view (if any) on this issue are considered; new problems, issues and tasks that have not yet been solved in this area are posed and discussed.
- Common, productive ways of activity are identified and used in accordance with their competencies and goals; distinguished productive ways of activity in solving problems of varying degrees of complexity.
- The opportunity to learn in situations as close as possible to professional activities.

Various tasks (tasks and questions) for self-control are presented, criteria for self-assessment are formulated.

- There are individual and group forms of activity.
- A complete (primary and secondary) list of references and links to Internet sources are provided; a general list of new concepts is compiled, the terms are used in educational materials; there is the ability of working with modern databases, access to modern literature is offered.
- Mandatory (minimum) and additional material (of increased complexity) is highlighted.

- There is accompanying software, simulators, modern scientific equipment.

Employers note high practical and theoretical training of students. The demand for graduates exceeds their number. Graduates are able to perform basic generalized job functions. The level of formedness of labour activities, the necessary knowledge, skills and other professional characteristics of graduates are at an advanced level. Most graduates (78%) continue their education in graduate and postgraduate studies, combining study with professional activity.

In the framework of the discipline "Project Activity" a number of fundamental and applied studies was conducted. The direction of research is solid state chemistry and the production of functional materials for various purposes, catalysis, electrochemistry and electrochemical synthesis on hydrophobized electrodes, organic synthesis. Most of the results are presented at conferences at various levels, as well as in articles in international journals. Orders for a part of the prepared project works were formed.

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