



Mining and Metallurgical Institute named after O.A. Baikonurov

Department of chemical processes and industrial ecology

**GRADUATE MODEL (BACHELOR)
Educational program**

6B05206 – Engineering ecology

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INTRODUCTION

The official inclusion of the Kazakh Higher School in the Bologna Process places the task of ensuring quality and quality management at the forefront of higher education modernization. A key aspect of this is the close connection between the educational outcome and the indicator of education quality, which is a system-forming factor in shaping the model of a specialist.

"A specialist model is a description of what a specialist should be fit for, what functions they should be prepared for, and what qualities they possess".

Current higher education standards are based on the qualification model of a specialist, where the dominance of the knowledge component prevails. These standards lack the possibility of assessing education quality based on indicators such as graduates' readiness for future professional activities and the level of professional motivation. The subject-knowledge orientation artificially divides the process of assessing the quality of specialist training.

Recent discussions widely consider transitioning from the qualification model to a competency-based model, i.e., one oriented towards professional activities. In the competency-based model, educational goals are associated not only with performing specific functions but also with integrated requirements for the outcome of the educational process. The competency approach encompasses, in addition to specific knowledge and skills, categories such as ability, readiness for cognition, social skills, etc.

Considering that decision-making occurs in complex dynamic systems, such as most modern enterprises and organizations, competencies can be understood in the context of the contemporary theory of self-organization, where they represent an important personal resource.

Modern conditions impose new requirements on graduates, with an increasing emphasis on systematically organized, intellectual, communicative, reflective, and self-organizing elements.

Employers increasingly seek not just qualifications, often associated with the ability to perform specific operations, but competence, which combines strict qualification and social behavior, the ability to work in a group, and initiative.

Based on domestic and foreign experience, ***the key, general professional and specific competencies*** of future specialists, as well as their components, have been identified.

When constructing a competency-based model of a specialist, levels of competency formation are distinguished – basic and advanced levels, with the goal of their staged development.

The basic level of competency is understood as the level that is mostly formed in first-year students and develops further in the learning process. The advanced level is the level that is usually formed in a higher education institution and continues to develop in the process of professional activity. The success of the competency-based approach to constructing a specialist model (graduate) is determined by a specific description of the formation of competency components in the process of professional

NJSC "KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I. SATBAYEV" development. To assess the level of achievement of key competencies by final-year students, a survey method can be used. Questionnaires are developed for each competency, containing a series of brief statements for which the student must choose one of the five proposed answer options: "yes," "more yes than no," "difficult to answer," "more no than yes," "no."

1 Specialist Model (Graduate)

1.1 Key Competencies

The core of the specialist model (graduate) of any university consists of **key** competencies. The key competencies of a specialist have a dual nature. On the one hand, they are not professionally conditioned. All modern specialists should possess these competencies regardless of their field of activity. On the other hand, key competencies are professionally significant as they form the basis for professional competencies, enabling them to be more fully realized.

An important feature of key competencies is that they allow graduates, if necessary, to be in demand in the labor market and successfully pursue careers in professions unrelated to their university qualifications.

Among the key competencies, one can highlight *informational*, *communicative*, *socio-legal competencies*, as well as the competence of *self-improvement* and *activity competence*.

•Informational Competence

The ability to navigate an information flow: the skill to find and systematize various information sources according to specific criteria; use rational methods of obtaining, transforming, systematizing, and storing information; update it in necessary situations of intellectual-cognitive activity. Computer literacy, proficiency in new information and multimedia technologies (email, the Internet), and the ability for critical thinking about information.

•Communicative Competence

Readiness to engage in communication for cognitive, business, and personal reasons. Understanding the features of formal and informal communication. Appreciation of the value of collaborative relationships, friendship, and trust between people. The ability to listen and hear others, empathy, respect for others, and self-respect as the foundation of communication. Knowledge and observance of national traditions, rituals, and etiquette. The ability to engage in constructive communication, maintaining its optimal duration; ability to conduct civilized dialogue. Knowledge of constructive conflict resolution methods and mending broken relationships. Critical self-assessment and the ability to timely admit mistakes and prove one's point.

Skills in public speaking and written language, as well as proficiency in foreign language communication. Experience in interacting with different people (by age, status, type of activity), ability to build partnership relations, work in a team, organize the work of performers, find and make managerial decisions.

•Socio-Legal Competence

Understanding the importance of one's social functions as a citizen of their country, a member of society, a stable positive attitude toward their social responsibilities. Knowledge of state symbols (coat of arms, flag, anthem). Knowledge of human rights and freedoms, the ability to implement them in various life situations. The ability to correlate one's interests with the interests of society. A focus on improving and developing society based on the principles of humanism, freedom, and

democracy. Experience in socially useful civic activities. Possession of a certain life position and internal readiness to implement it. The ability to take responsibility, participate in the functioning and improvement of democratic institutions. Tolerance, respect, and acceptance of the "Other" (race, nationality, religion, status, gender).

These three competencies (informational, communicative, and socio-legal) are truly fundamental, necessary for every modern person, regardless of education level, profession, place of residence, etc.

Considering other key competencies, two more key competencies are highlighted.

• ***Competence of Self-Improvement***

The need for self-development. The ability to build a personal life strategy. Close unity of intellectual development with personality formation, the ability to cope with contradictions and uncertainties in one's life experience. The ability to independently control the course of one's intellectual development and achieve heights of professional mastery and creativity. Knowledge structuring, situational-adequate knowledge actualization, expansion, and enhancement of accumulated knowledge. Language and speech development; mastery of the culture of the native language. Adequate assessment of achievements in self-development and setting new promising tasks.

Knowledge and observance of the norms of a healthy lifestyle, physical education of a person, freedom, and responsibility in choosing a lifestyle.

Another important key competence is the competence of *activity*. This competence is basic for all other competencies since they manifest primarily in the process of certain activities.

• ***Activity Competence***

Orientation in various types of activities. Knowledge of means and methods of activity: planning, designing, modeling, forecasting. Experience in various types of activities: cognitive, educational, playful, research, etc. The ability to identify and formulate a problem, offer a range of solutions, and choose the most effective one; readiness to take responsibility for one's choice. Readiness for evaluative activity: the ability to give a reasoned assessment of different views and positions; realistically assess one's features and capabilities, including the boundaries of one's competence.

Thus, the following key competencies of a specialist by Educational program 6D05206 – Environmental Engineering have been identified:

- *Informational*
- *Communicative*
- *Socio-legal*
- *Self-improvement*
- *Activity.*

1.2 General Professional Competencies

The second component of the specialist model (graduate) consists of competencies that a specialist (graduate) of Educational program 6B05206 – «Environmental Engineering» should possess.

Five general professional competencies can be identified for a specialist (graduate):

1) Competence in monitoring achievements in the field of "Ecology and Sustainable Development";

2) Competence in designing long-term and short-term goals while mastering the profession of an environmental specialist;

3) Competence in using new technologies and organizing independent cognitive activities;

4) Competence in interacting with various structures (management, project, production, etc.) to solve professional tasks;

5) Competence in professional self-education.

B1 - Application of the basic laws of natural sciences (biology, geography, and chemistry) and the use of methods of mathematical analysis and modeling in solving problems in the field of eco-analysis and eco-technology, the ability to find solutions to environmental problems;

B2 - Ability to use modern information technologies, process information using applied programs and databases for calculating technological parameters of equipment, indicators of technological processes in the field of ecology, and monitoring of the natural environment;

B3 - Proficiency in communication skills in the state, Russian, and foreign languages;

B4 - Knowledge of all environmental issues and prospects for development in the field of environmental and safe technologies for these problems;

B5 - Ability to conduct environmental analysis and make appropriate decisions;

B6 - Skills in conducting chemical analysis, methods of obtaining and studying substances and materials, environmental studies;

B7 - Skills in working with equipment when conducting experiments, safe handling of various chemical and biological objects;

B8 - Knowledge of the basic methods and ways of developing environmental conservation measures; understanding the essence and significance of the interrelation of production processes and their impact on industrial safety, enabling the rational use of natural resources and reducing the negative impact on the environment.

1.3 Special Competencies

The specialist model (graduate) must include competencies that characterize them as a worker in a specific sphere of production, science, or culture. Therefore, it is necessary to highlight special competencies that reflect readiness for a narrow area of professional activity in the field of environmental engineering.

Special competencies are associated with the specialist's ability to use knowledge, skills, and abilities for solving professional tasks within a specific area. They are considered as the implementation of key and basic competencies in relation to the specifics of professional activity in the field of environmental engineering.

These competencies are referred to as subject-oriented. They are formed in the process of mastering specialized disciplines and disciplines of specialization. The graduate must have a holistic understanding of a specific science (area of scientific or

NJSC "KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I. SATBAYEV" technological knowledge) and be prepared for professional activities in the field of environmental protection and ecology.

The graduate of the educational program 6B05206 – «Environmental Engineering», possessing special competencies, should be able to and have skills in:

- Conducting experimental studies of natural processes and phenomena, controlling parameters of negative impacts on the environment, and evaluating their level; preparing documentation for environmental expertise;
- Effectively applying knowledge of the fundamental laws and regularities of the functioning and development of nature; conducting assessments of the impact of economic and other activities on the environment;
- Developing measures to enhance the environmental sustainability of production activities and the rational use of natural resources;
- Processing and analyzing data from experiments and observations, interdisciplinary research based on knowledge of physical-mathematical, chemical-biological, and geographical regularities;
- Meeting environmental safety requirements and environmental regulation in production.

A specialist in environmental engineering with special competencies:

- Demonstrates knowledge of global and regional environmental issues, environmental safety and sustainable development, the basics of environmental legislation, and environmental management and marketing;
- Possesses professional skills in developing measures to prevent depletion and pollution of water, soil, mineral-resource, and biological resources; using new environmental and resource-saving technologies;
- Masters scientific research methods, understands the role of science in societal development;
- Is knowledgeable about environmental risk assessment, methods of comprehensive eco-economic assessment of the consequences of anthropogenic activities.

2 LEVELS OF FORMATION OF KEY COMPETENCES

Information Competence

Basic Level

- Ability to use catalogs, select literature on a given topic;
- Initial skills in working with a personal computer;
- Ability to search for information on the Internet, use email;
- Ability to select necessary information, compose a message plan, and structure material according to the plan.

Advanced Level

- Ability to work with computer programs, if necessary, mastering new specialized programs;
- Ability to gather information on a particular issue reflecting different perspectives, approaches, concepts, etc., systematize it, and analyze;
- Ability to critically evaluate the obtained information.

Communicative Competence

Basic Level

- Willingness to engage in communication for cognitive, business, personal motives;
- Willingness and ability to listen to others;
- Ability to conduct a civilized dialogue;
- Ability to express thoughts coherently;
- Ability to adjust one's behavior during communication;
- Experience in public speaking;
- Experience in written communication;
- Willingness to work in a team;
- Willingness to engage in mutually supportive relationships;
- Willingness to put oneself in another's place, see the situation and one's behavior through their eyes;
- Sense of self-respect and respect for others.

Advanced Level

- Experience in multilingual communication;
- Readiness to find constructive ways to resolve conflicts;
- Ability to demonstrate leadership skills;
- Ability to manage the communication process;
- Experience in interacting with different groups of people (differing in age, status, type of activity, etc.).

Social-Legal Competence

Basic Level

- Knowledge of state symbols of the Republic of Kazakhstan (flag, coat of arms, anthem);
- Compliance with the laws of the Republic of Kazakhstan;
- Adherence to norms and rules of behavior in society;

- Fulfillment of civic and social obligations;
- Readiness to defend one's rights (as a citizen, student, consumer, etc.);
- Readiness for dialogue and collaboration with people of different races, nationalities, religions, etc.

Advanced Level

- Knowledge of one's rights;
- Ability to take responsibility;
- Participation in the activities of public organizations, self-government bodies, etc.;
- Ability to justify and express one's position on issues related to the values of social and political life.

Activity Competence

Basic Level

- Understanding of various types of activities and the structure of activities (planning, implementation, analysis of results);
- Experience in planning and organizing one's own activities;
- Experience in analyzing and evaluating the results of one's own activities;
- Experience in participating in collective activities.

Advanced Level

- Ability to plan the activities of others;
- Readiness to use techniques, methods, and technologies for organizing joint activities;
- Ability to analyze the results of joint activities.

Self-Improvement Competence

- Basic Level
- Understanding the necessity of continuous development and education in the modern world;
- Knowledge of one's characteristics (strengths, weaknesses), the level of one's development;
- Aspiration for self-improvement.

Advanced Level

- Ability to set goals (tasks) for self-development, self-education (short-term and long-term perspectives);
- Ability to independently implement and control the course of one's development;
- Ability to objectively assess the achieved results;
- Responsibility for choosing a lifestyle.

Learning Outcomes of the Educational Program:

LO-1 Demonstrate the ability to ensure the safe operation of technological equipment and maintain sanitary and hygienic conditions of the enterprise as a whole, observing workplace safety rules and environmental protection regulations.

LO-2 Demonstrate knowledge of socio-ethical values and trends in the social, political, and economic development of society in professional activities. Exhibit leadership skills and readiness to maintain partnership relations, displaying intolerance towards any manifestations of corruption and maintaining a strong civic position.

LO-3 Possess knowledge of natural sciences (chemistry, mathematics, physics, geography, and informatics) that underlie the concepts, theories, and principles of environmental engineering.

LO-4 Demonstrate skills in conducting chemical experiments and processing obtained results to assess environmental pollution of soil, water, and the atmosphere.

LO-5 Possess skills in selecting methods, objects, materials, and sampling for scientific monitoring and using them to assess the impact of industrial enterprises on various components of the biosphere and the health of workers.

LO-6 Utilize skills in working with equipment during experiments and safely handling various chemical and biological objects.

LO-7 Analyze socially significant local, regional, and global environmental problems and human anthropogenic activities.

LO-8 Possess knowledge of the theoretical foundations of industrial processes, technological schemes, and interrelationships of stages and features of technological processes in the field of ecoanalytics and ecotechnology.

LO-9 Possess methods of environmental management and decision-making used in the development, design, and operation of safe technological processes.

LO-10 Apply innovative methods and tools for monitoring the state of the natural and man-made environment. Independently compile environmental passports, fill out environmental reporting forms, and analyze and apply the Environmental Code and other regulatory documents in professional work.

LO-11 Develop advanced green technologies for creating low-waste and zero-waste processes based on knowledge of modern methods of qualitative and quantitative analysis of environmental components.

LO-12 Apply engineering skills in improving existing and developing new technological processes from the standpoint of energy and resource conservation, introducing advanced green technologies, and minimizing the impact on the environment.

LO-13 Demonstrate managerial decisions in organizing work and implementing environmental measures, as well as skills in task execution control.

LO-14 Apply knowledge of basic methods and ways of developing nature conservation measures, understanding the essence and significance of the relationship between production processes and their impact on the safety of industrial production, allowing rational use of natural resources and reducing negative impact on the environment.

LO-15 Evaluate the role of social and humanitarian sciences, communicate to the extent necessary for professional communication, and develop one's potential.

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