

COMPETENCY-BASED APPROACH IN HIGHER EDUCATION: COMPETENCY-BASED MODEL OF THE ENGINEER FOR THE FOOD INDUSTRY

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ABSTRACT

The competency-based approach in higher education is considered, and in particular, scientific views on the competencies of an engineer for the food industry are studied. A comparative analysis was carried out in order to identify the key competencies necessary for a modern specialist to successfully realize its creative potential in a market economy, information society and innovative technologies. A developed competency-based model for training an engineer in the food industry is proposed.

The object of research is the competency-based approach in the preparation of a food process engineer.

Investigated problem is that engineering education should not only prepare a specialist endowed with knowledge and skills. It should be aimed at creating a competitive specialist and a successful personality. At present, in Ukraine, the food industry does not have a competency system that is common for employers, specialists, and higher education institutions. This study aims to create such a framework in the form of a competence model of an engineer for the food industry.

Main scientific results: the necessary components of the competent model of a modern engineer for the food industry were identified. The essence of the competency-based approach to the professional training of an engineer in the context of modernization of education is revealed. The modern scientific view of the requirements for food engineers is analyzed. The results obtained are adapted to the needs prevailing in the food industry and the field of public catering.

Field of practical use of research results: a comparative analysis allows to systematize scientific views on the desired competencies of scientists, researchers and engineers in the food industry. Which, in turn, will help to better inform students about the sought-after qualities and make a decision on revising the curriculum in the future.

Innovative technological product: developed competency-based model of an engineer for the food industry.

Scope of the innovative technological product: application of the competency-based approach in higher education using the proposed competency-based model of an engineer for the food industry.

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1. Introduction

As a result of joining the Bologna Agreement, Ukraine has committed itself to organize a higher education system on a competent basis. Therefore, in the field of education, the terms “competency” and “competency-based approach” are becoming increasingly relevant.

A competency-based approach implies, first of all, the ability of a specialist to realize its knowledge, skills, qualities and other competencies (components of its potential) [1].

Young researchers and engineers make up the majority of graduates for the food industry. The rapid development of research and development in the field of food production technology poses new requirements for young specialists, which should be considered in the context of the competency-based approach in higher education [2, 3].

The food industry of Ukraine occupies a significant share in the total production sector of the economy. Accordingly, employment in the food industry is measured by many thousands of people. Food scientists and technologists need a variety of skills in a globalized food production sector, including food or science and technology skills, as well as general or intuitive skills [4, 5].

In this regard, engineering education for the food industry should be aimed not only at the formation of a competitive specialist, but also a successful personality. Therefore, improving the effective training of future industrial engineers of the food industry for creative professional activities is an urgent and necessary task. One of the ways to solve it may be the acquisition by students of a set of key competencies in the context of modernization of education. It should be borne in mind that professional skills are formed both during the educational process and during practice [6, 7].

At the moment, the food industry does not have a competency system that is common for employers, specialists, and higher education institutions. This study aims to create such a framework in the form of a competency-based model of an engineer for the food industry [8]. Therefore, this work is relevant and timely.

Also, the need for a coherent system of competencies and a clear understanding of them is of particular importance in the modern information society, in the context of the development of online services for employment, personnel search and job search. The requirements placed by employers for applicants should be used in education to form the relevant competencies of future young scientists, engineers and researchers.

1. 1. Object of research

The object of research is the competency-based approach to education through the construction of a competence-based model of an engineer for the food industry.

1. 2. Description of the problem

Under the Bologna Convention, major changes have taken place in the field of education. There was a need for state educational standards on higher education, in which the competency-based approach was declared as the dominant educational process. The main objective of the implementation of the competency-based approach is to create a socially mobile specialist who is able to easily move both in horizontal and vertical social systems, adapt to work in rapidly changing life situations, competitive, able to move away from existing stereotypes and offer new technologies solving professional problems [9].

In the context of improving and modernizing the higher education system, the search and implementation of advanced technologies for the training of competent personnel continues.

In this situation, it is understood that a training system based on the reproduction of knowledge, skills and abilities (KSA) is outdated and does not cope with the task of training modern highly qualified specialists, including engineers in the food industry.

The activity of food industry enterprises is closely connected with the introduction of new types of products into production, the expansion of their assortment, the development of innovative food technologies and equipment that must meet the requirements of resource, energy conservation, safety and quality. All this dictates new approaches in the training of competent process engineers who will be ready for creative work, professional self-development and improvement. A constant lack of qualifications in scientific, research and engineering positions dictates the need to train competent process engineers for the food industry. In addition, the

situation prevailing in the scientific and technological development of modern society requires a change in the thesis that “an engineer is a technical specialist who solves narrow professional tasks”. The most important task of a modern engineer is to organize the social conditions for the introduction of technical systems in natural and social systems with an assessment of the social consequences of such an introduction [10].

Therefore, it is precisely the competency-based approach in higher education that should determine the key competencies that a modern food engineer must possess.

The “competency” category was first introduced by Noam Chomsky in 1965. In his opinion: “competence is a deep structure, a system of generative processes, mental reality.” This category was further developed in the work of John Raven “Competence in modern society: Its Identification, Development and Release” (1984). Raven identified 37 heterogeneous factors leading to a positive result. Among them: good memorization, accurate perception, critical thinking, productivity of thinking, mnemonic ability, independence, motivation, a clear understanding of the goal, subordination of this goal to various means, the ability to work in a team, the ability to communicate well. Subsequently, the authors selected factors from this set and associated them with various fields (cognitive sphere, personality sphere, interaction, etc.) [11].

In this regard, it is necessary to specify what specific and non-specific competencies of a future engineer need to be developed in the training process to form a “competent graduate” in the food industry.

However, today the food industry suffers from a lack of qualifications, namely in scientific, research and engineering positions.

A shortage of qualified scientific, research and engineering personnel for the food industry also exists in the UK. According to the forecasts of the Federation of Food and Beverage Producers (2016), by 2022 this sector will need 109 thousand new personnel at all levels to meet growing demand [12].

This is also confirmed by Wakeham’s review of the “Degree of STEM Support (Science, Technology, Engineering and Mathematics) and the Employment Opportunity of Graduates” (2016). The authors emphasize that the high rate of change creates additional challenges for both higher education and industry. In the field of STEM (Science, Technology, Engineering and Mathematics), the number of graduates and their skills should be in line with future demand.

In order to solve these problems, a group of researchers from Nottingham (UK) (Great Britain) developed a language tool that can be used to determine the competencies of food graduates. Researchers have set themselves the task of finding commonly used terms and relevant definitions for the desired graduate skills used by industry stakeholders.

Materials were collected by the authors using assessment interviews and processed using thematic analysis and a modified Delphi peer review methodology. Based on data obtained from a representative sample of study participants, a set of typical attributes and associated definitions was created that may be in demand for food science graduates.

The final core document, Competencies for Food Graduate Careers, has been received. The terminology associated with it structures in 11 groups of 48 elements, classified as behavior, skills or knowledge. The conditional groups include the following: “behavior”, “communication”, “innovation and prospects”, “numbers, data and information technology”, “problem solving”, “effective work”, “global perspective”, “business”, “technical and workspace”, “social and professional recognition” and “work with other people”[8].

Researchers identify 14 typical “roles” for graduates in the food field. Nine of these roles are distinguished from the point of view of the product life cycle, from its concept to its consumption by the end user. These include: a technologist for the formation of the organoleptic properties of the product; retail technologist; customer support technologist; technologist of specifications and systems; production technologist; material and research technologist; laboratory technologist; Technologist for the development of new products and processes; a technologist performing post-graduate research and increasing its academic degree.

The other five “roles” are more generalized and all-encompassing. Among them: audit (not only in a single company), advanced training, work on a food product, legal and regulatory work; sustainable development, environmental protection, ethics, combating threats [9].

A group of European researchers from different countries conducted a study of “ideal skills for European scientists and technologists in the food industry” with the aim of “identifying the most sought-after knowledge, skills and competencies.” At the core of their research, they used the identification of knowledge, skills, skills demanded by employers. Researchers collected baseline data from employers from March 2010 to August 2011 at 16 workshops in 16 countries. More than 300 local employers have expressed the desired qualities for scientists and technologists in the food industry. The participants suggested the maximum possible number of skills, which was 3348. The obtained descriptive data were evaluated and analyzed in statistical factor tables and tests according to the chi-square criterion. Of the proposed ideas for skills, the most desired in general was “sociability” (13 % of cases). A separate analysis of 792 skills in the food sector revealed the skill of “product development” as the most demanded by employers (28 % of cases).

The obtained data indicate the high importance of skills that are not specific to the food sector. This is characteristic of all regions, areas of employment and the level of competence of a specialist in the European food sector. Also, an urgent need for increasing the level of training of scientists and technologists not only coming to the food industry, but also already working in it, is identified [13].

A team of European scientists conducted a study of self-esteem of technical skills and interpersonal communication skills of students in the field of food sciences and technology. Through an online survey (questionnaire), 267 students from 20 countries were interviewed using a five-point Likert scale. The obtained data from the survey were analyzed using the tests of Friedman or Kruskal Wallis.

Researchers distinguish such general personal qualities as: responsibility, positive attitude (to one’s activity), ability to work with others, ability to solve problems, sociability. Among the general technical qualities distinguish: quality control, hygiene, food safety management, the ability to research, knowledge of food production technology, food chemistry, microbiology, the ability to conduct product development.

The results of studies carried out by European scientists have revealed trends in increasing the level of education of specialists in the food science and technology sector. Compared to previous years, an increasing number of students set themselves the goal of obtaining a Ph.D. degree. A significant part of the students surveyed show a strong desire to work in small and medium-sized companies [14].

So, for example T. Lazareva notes that the application of the competency-based approach in the training of future engineers allows to take into account the main triad of training, education and development goals [15].

1. 3. Suggested solution to the problem

To solve the described problem, first of all, it is necessary to get acquainted with already existing theoretical and practical developments in this field. It is necessary to conduct a literature review of research and views on the competencies of a modern specialist in general, as well as an engineer in the field of food production – in particular. A review of the literature allows to define a wide range of terms used, to describe the desired competencies that a graduate should possess.

Initial information for the study was collected from a wide range of various sources, including official documents, reports, materials on higher education, as well as books, journals, articles on job search and employment of graduates of the food sciences.

Different phrases were used in different sources to describe the same competencies, therefore they were grouped and nominal terms were chosen for simplicity. Based on this, a competence model of an engineer for the food industry was developed.

The purpose of the development of the model is the formation and development of the general and subject competencies of a specialist – a process engineer for the food industry.

2. Materials and Methods

The objectives of this research were achieved through the analysis of theoretical knowledge and wide practical experience in introducing a competency-based approach in higher education. The theoretical work consists in studying the sources of scientific information in accordance with the chosen object of research – the competence model of an engineer for the food industry.

In the course of research, such widely used general scientific logical methods of theoretical analysis and synthesis, abstraction and concretization, induction and deduction were applied.

In accordance with the objectives of research, a general population is formed, consisting of a large number of competencies. Based on this general set of competencies, groups are determined by which they are distributed. At the same time, they check to what extent the developed definitions of any individual competencies are closely related to others.

The individual competencies of a specialist are grouped based on such characteristics as type (knowledge, skills, personal qualities, etc.), specificity (general, subject-matter of this specialization).

The studies were carried out by studying, generalizing and improving the competency-based approach in higher education through the competence model of the engineer for the food industry in higher educational institutions of Ukraine, namely the Kharkiv State University of Food Technology and the Kharkiv Trade and Economic College of the Kyiv National Trade and Economic University.

3. Results

A competency-based model has been developed as the most appropriate specialist model, taking into account the needs of the market for food production engineers, the requirements of enterprises for such employees, as well as the needs of the specialist as a harmonious comprehensively developed personality.

The competency-based model of a specialist is a structured set of mandatory, defined and assessed competencies in all their possible manifestations (knowledge, skills, personal qualities, etc.). The competency-based model – as a system of competencies of an engineer for the food industry includes the following groups:

Group 1. Worldview and personal qualities:

- ability to form a worldview on the development of society and man;
- presence of personal and professional values;
- desire to be a professional in their field;
- responsibility for the consequences of their actions;
- confidence;
- reliability;
- independence, autonomy - the ability to work autonomously;
- leadership;
- initiative;
- enterprise; entrepreneurial ability;
- determination;
- critical thinking;
- problem-oriented thinking;
- ingenuity and resourcefulness;
- thoroughness and attention to detail;
- positive attitude;
- emotional intellect;
- innovative thinking;
- openness to the perception of new ideas;
- self-understanding, self-awareness, introspection;
- self-development, self-training;
- self-motivation; avoidance of excessive self-confidence - the ability to realize the lack of available information to solve a specific problem;
- stress resistance and the ability to quickly restore physical and mental state;
- intercultural workspace;
- cultural sensitivity;
- susceptibility;
- representativeness – attractive to others;
- passion for the subject of their professional activities.

Group 2. General (non-subject) knowledge:

- knowledge of modern information technologies;
- knowledge of foreign languages of international communication in the scientific community;
- awareness of environmental protection (environmental knowledge);
- understanding of economic mechanisms and business processes;
- commercial awareness.

Group 3. Applied (subject) knowledge:

- organization of catering and restaurant facilities;
- equipment of catering and restaurant facilities;
- food technology;
- technology of restaurant industry products;
- physiology and nutrition of food products;
- food chemistry;
- microbiology; hygiene and sanitation;
- technological control of production;
- decorative and artistic design of restaurant products.

Group 4. General (non-subject) and interpersonal abilities and skills:

- ability to plan and organize their work, activities;
- ability to choose priorities in their activities;
- ability to solve tasks by posing questions and finding answers to them;
- ability to make informed decisions;
- ability to adapt to changing conditions, circumstances, requirements; ability to communicate verbally;
- ability to communicate in writing;
- ability to listen and perceive the point of view of another person;
- ability to conduct teamwork and collaborate with others;
- ability to establish business relations and build relationships.

Group 5. Applied (subject) abilities and skills:

- work experience;
- ability to design the technological process of food production and compile related regulatory and technical documentation;
- ability to choose and apply modern information technology in practice, the ability to use software tools in their professional activities;
- ability to find, process and analyze information from various sources;
- ability to manage projects;
- ability to develop a new product;
- ability to conduct comprehensive research;
- ability to use innovative technologies;
- ability to analyze current trends in the development of food technology and restaurant industry;
- ability to use professional knowledge in organizing the production of food products, their storage and transportation;
- ability to ensure the safety of working conditions and work in compliance with safety regulations;
- ability to draw up reports, keep working documentation within its competence.

4. Discussion

The difference between a competent food technology engineer is that the first one has not only knowledge, abilities, skills of a certain level, but also the ability and willingness to implement them in a robot.

The food process engineer deeply appreciates its specialty and has an internal motivation for quality implementation in it.

Unlike just a qualified specialist, a competent specialist – an engineer in the food industry – not only possesses the necessary knowledge, skills, but is capable, willing and motivated to implement them in its professional activity.

Only careful organization of the educational process will allow to get the result in the form of the final competence of a specialist. In modern conditions, knowledge, skills and abilities become not the ultimate goal of the learning process, but only components of the result, along with a large number of competencies of the food industry engineer that was identified.

The final result of a comparative analysis of modern scientific views on the competencies of an engineer for the food industry, in our opinion, will be important for employers, teachers, students and graduates, since it creates the basis for understanding the types and essence of the required competencies.

This work allows to use the developed idea of competencies in the development of students and hiring graduates for all interested parties in the food industry.

Educational institutions can use the results of work as a tool for developing students' skills in recognizing competencies that are desirable for graduates in the corresponding field of training. Studying the results of this research can help increase the opportunity for students and graduates of higher educational institutions to get a job in the food industry.

While working on the article, the awareness of the importance of the competencies considered was not sufficiently deeply studied from the point of view of various types of employers. Therefore, this will be our research in the future.

It should be noted that many of the examined competencies were similarly identified by other researchers in this field. However, some of the other competencies examined require further study and examination with a view to understanding them more deeply and correctly.

What it is in common with the views of many other researchers is that the application of a competency-based approach should serve as a basis for future specialists to acquire a high level of independence, responsibility and motivation in their professional activities.

The proposed model of a modern engineer-technologist of food production implies, first of all, a professional, competent, creatively developed person with developed spiritual, moral and business qualities. It involves the ability to set and solve any tasks of professional activity, to direct personal orientation to the search for values and norms of behavior.

5. Conclusions

The growing demand and the rapid pace of development of innovations and technologies in the food sector increase the qualification requirements for specialists in this field, and especially for researchers and engineers.

It follows from this that the training paradigm based on the reproduction of knowledge, skills is already outdated and can't solve the problem of training qualified specialists in the food sector.

The developed system of engineer competencies for the food industry can play a big role in creating state educational standards in which a competency-based approach would be key.

In a market economy, the development of the necessary qualities of scientists, researchers and engineers in the food industry must be carried out on the basis of competencies, primarily demanded by employers.

As an analysis of studies in various European countries has shown, the views of employers on the sought-after qualities of a specialist in the food sector vary significantly depending on factors such as the geographical region, scope of employment, and level of responsibility of the specialist. The established differences of views had a significant impact on the choice of the first three positions from a set of both general qualities and specific qualities of the food sector.

It is revealed that the most demanded competencies of a specialist in the food industry are not equally distributed.

Competence contains not only knowledge and skills. This concept also includes responsibility, motivation, ability to solve problems, orientation in activity. That is everything that helps a specialist to solve problems, choose the right path, achieve goals.

Let's recommend that, in training specialists, first of all, to develop key competencies, and then, in hierarchy, the competencies included in the acquired content. Teachers, students, young professionals and employers will receive a tangible positive effect from the existence of a developed system of competencies for typical positions for which graduates of food specialties are recruited.

Further research in this area should be focused on the competencies that the employer wants to see in the graduate in technological specialties in the field of food sciences. Therefore, in higher

education institutions, practical activities should be carried out in combination with scientific and experimental work aimed at introducing a competency-based approach into the educational process. This work should be focused on testing, developing and substantiating new ideas to improve the effectiveness of the educational process.

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