UDC 377.36:37.013
DOI 10.35433/pedagogy.1(96).2019.44-50

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MODEL OF PROFESSIONAL COMPETENCE FORMATION OF FUTURE SPECIALISTS OF FOOD TECHNOLOGIES IN THE PROCESS OF STUDYING NATURAL SCIENCE DISCIPLINES AT COLLEGE

The article states the necessity of educational process restructuring that takes into account the modern requirements of the level of professional competence formation of graduates of higher educational institutions. The model of the formation of the professional competence of future technicians of food products production is grounded in the process of studying natural science disciplines. The structure of the model is described and consists of five blocks: 1) task-oriented; 2) theoretical and methodological; 3) informative; 4) organizational and procedural; 5) estimated and productive. Furthermore, the interrelationships among them are highlighted. The significance of the leading pedagogical conditions in the process of formation of professional competence is determined. The essence of the definitions of "model", "modeling" and expediency of modeling method as a means of studying pedagogical processes and phenomena is revealed. It is stated that increasing the level of professional competence formation of future specialists in food production will depend on the development of all its components (personal, cognitive, activity, reflexive and estimative). The results of experimental verification of the developed model effectiveness in the educational process of colleges by introducing the author's technology, which was based on the integration of natural and professional disciplines (content-related, methodological, organizational, practical), are presented. It is proven that the professional orientation of fundamental natural science disciplines significantly increases the motivation to study professional disciplines, and it contributes to the awareness of the importance of the natural component in future professional activities. The implementation of an active and interactive forms and methods of teaching, the improvement of the scientific-methodological support of the educational process contributed to the activation of students' cognitive activity and urged to an active and professional-creative search.

Key words: *model, modeling, professional competence, pedagogical experiment, integration of natural and professional science disciplines.*

Introduction. The formation of the professional competence of food technology specialists is a complex and multidimensional process, which is aimed at a highly professional specialist's training, as well as a harmoniously developed personality. Society dictates new requirements for the training of a modern specialist; therefore, the problem of professional training is being updated in new educational institutions.

It is possible to solve this problem if the educational process is constructed as an integral system in which the purpose, task, final result, content, and methods and forms of achieving this final result are clearly defined. That is why the question of finding optimal and effective methods in pedagogical research is a focus of scientists. One such scientific research method, the modeling method, is based on the development and study of models.

Analysis of recent research and publications. The analysis of recent studies and publications shows that scientists and practitioners have widely used the modeling method for the study of pedagogical processes and systems. The expediency and effectiveness of using the modeling method in pedagogical science are substantiated in the writings of S. Arkhanhelskyi, V. Afanasiev, I. Blauberh, V. Venikov, B. Hlynskyi, V. Hlushkov, A. Dakhin, A. Dubaseniuk, M. Lazareva, I. Novyk, V. Shtoff, and others. I. Boichuk (pharmacists), S. Gorobets

(economists), O. Denderenko (ship engineers), O. Derevianko (mining engineers), G. Zaichuk (marketers in the tourism industry), O. Kovtun (aviation operators), D. Kostiuk (electrician technicians), O. Peredrii (commodity experts), and I. Stadniichuk (mechanical engineers). They dedicated their writings to the problem of modeling the pedagogical processes of forming the competence of future specialists in the sphere of production and services. H. Berezhna, M. Lobur, L. Krainiuk, P. Pyvovarov, N. Sychevska, O. Turytsa, and L. Yancheva studied various aspects of the problem of the formation of certain competencies in the process of professional training of future specialists in the food industry.

However, the problem of developing the model for the formation of professional competence of future technicians of food production in the process of studying natural science disciplines has not yet been the subject of separate research.

The purpose of the article is the theoretical substantiation of the developed model of professional competence formation of the future technicians of food production in the process of studying natural science disciplines. The presentation of experimental model implementation results in the educational process of colleges is also examined.

Results and Discussion. The relevance of using the method of modeling as a means of studying pedagogical processes was emphasized by I. Ziaziun. The scientist notes that by modeling one can reproduce not only the statics of the didactic process, but also its dynamics [7: 67]. Z. Kurliand defines modeling as a research of cognitive objects on their models, the construction and learning of really existing objects models [2: 336]. Thus, it is the modeling method that will enable us to define and substantiate the goals and tasks of the educational process; content, forms, methods, means of studying natural science disciplines, the choice of which is predetermined by modern pedagogical technologies; to design the general organization of professional training in the study of natural science disciplines; to predict the results of the process – formed competencies which are the components of professional competence. The modeling method requires the construction of a scientifically grounded model of the professional competence formation of future specialists.

In dictionaries, "model" is defined as an imaginary or conditional (image, description, diagram) image of an object, process or phenomenon, which is used as it's representative [5: 535]. In scientific literature, scholars interpret the concept of "model" differently. S. Vitvytska defines the model of the didactic process as a reference submission on training, its construction, which allows us to identify and analyze the connection among probable, expected and desired changes of the researchable object [6: 158]. I. Ziaziun characterizes the model as a sign system, with which one can study the didactic process as a subject of research, to show in integrity its structure, functioning and to preserve this integrity at all stages of the research [7: 67]. Consequently, the creation of a model is the construction of the structure and logic of the pedagogical process that will form the professional competence of future specialists.

The reason for the development of such a model was the need to increase the level of efficiency of training of a competent food specialist, which depends on a qualitative fundamental natural- science component.

The overall structure of the proposed model consists of five blocks: 1) task-oriented; 2) theoretical and methodological; 3) informative; 4) organizational and procedural; 5) estimated and productive. Among these there is a system of connections and correlation (Fig. 1).

The task-oriented block reflects the requirements and needs of a modern society in competent experts in the field of food technology, as well as the purpose of research. The aim is to create the professional competence of future technicians in the process of studying natural science disciplines. This block has a significant impact on the design of content, methods, organizational forms and learning means, which are based on the stated approaches and

principles. That is to say that the typology of the entire structurally functional system depends on it.

On the basis of the analysis of Yu. Babanskyi's works, the model that was developed is considered as a complex system that is formed by interconnected structural (purpose-motivational, theoretically-cognitive, practical-active, control and reflective) and functional (stimulant and motivational, cognitive, developmental and corrective) components. The defined components are reflected in the theoretical and methodological block.

The purpose-motivational component includes a set of goals, motives, and needs, including motivations for future professional activity and learning activities in general. This is a process of knowledge of reality. The formed motives for constant self-improvement and self-realization are a powerful "engine" of personal formation including the achievement of high results in professional activity. The purpose- motivational component is decisive in the process of any activity, affecting other components and giving rise to the possibility of their formation.

Theoretical-cognitive component involves possessing a complex of knowledge about the basic fundamental laws of nature. These include physical and chemical phenomena and processes occurring during technological operations with food and raw materials; chemical composition, properties of chemical compounds and their changes in different conditions, which affects the formation of organoleptic and nutritional properties of food; the peculiarities of the functioning of living systems and the substantiation on this basis of the nutritional value of the main nutrients; elementary knowledge about greening of production and creation of ecological products, as well as the role and place of a person in the biosphere and its importance as a global geological force in the stabilization of ecosystems. The complex of knowledge is divided into groups: 1) fundamental basic knowledge; 2) professional; 3) practical; 4) socio-ideological.

Practical-activity component involves the formation of skills and abilities of students to apply the knowledge in future professional activities. These include the ability to establish causal-consecutive relationships between the properties of substances and their use; chemical composition of food products and their organoleptic and nutritional properties; the ability to use physic-chemical, biological knowledge for the management of technological processes, which depends on the speed of preparation, quality, appearance of the product, its nutritional value, physiological significance; the ability to apply the acquired knowledge and skills of working with chemical equipment, reagents, chemical research methods for quality control of finished products, preparation of solutions; the ability to apply self-study skills for self-improvement and implementation in the profession; the ability to adapt in society, possession of communicative culture (general and professional); the ability to extract and use information and information technologies. It is advisable to classify the complex of skills according to the following groups: 1) intellectual; 2) technologically-professional; 3) professional-creative; 4) instrumental-laboratory; 5) communicative; 6) socio-adaptive; 7) informative.

The control and reflective component provides the opportunity to carry out systematic control by the teacher and self-control and self-esteem from students, which is related to the ability to independently assess the level of competencies acquired and their importance in future professional activities, critically address their own achievements and performance. The control and reflexive component involves the formation of the students' ability to engage in continuous self-improvement and self-development, as well as a constant updating of knowledge, experience, skills in accordance with the needs of production and their own needs and motives.

All structural components are closely interrelated and implement a competent approach in the process of training future specialists, which reflects the readiness of the graduate for real professional activities and the ability to apply the experience in further social activities.

The model performs certain functions. Each structural component of the model has a specific functional significance, which is reflected in the following relationships: purpose-motivational component ↔ stimulant and motivational, theoretically-cognitive ↔ cognitive, practical-active

↔ developmental, and control and reflective ↔ corrective. The functions of the system are reflected in the functional components of the model, which will be considered in more detail.

The stimulant and motivational component contributes to the formation of interest in learning activities in general and future professional activities. The principle of professional orientation of natural science disciplines is realized in this component, which allows for significantly intensifying the cognitive activity of students to stimulate the conscious need to master not only professional knowledge and skills, but also fundamental natural skills, without which the process of professional realization of the individual cannot be maximally effective and complete. The stimulant and motivational component involves the development and application of a set of incentives (verbal, actionable, evaluative, and material) that positively influences the cognitive process.

The cognitive component is aimed at the process of complex system acquisition of knowledge concerning the general laws of development of natural and artificial systems; the physical and chemical processes on which the principles of operation of technological equipment and apparatus are based; the laws that affect the technological processes of culinary food processing. The cognitive component involves obtaining new knowledge from various information sources. There is a connection with the principle of the computerization of the educational process in professional educational institutions.

The developmental component is aimed at the individual development of the subject of the educational process. This includes the formation of a professional person, who is a competent specialist with a socially mature attitude and established moral and ethical standards. This person should also be environmentally conscious. In the global sense, it is aimed at forming the proper professional competence of the future technicians of food production. The complex of components of professional competence (competency) is reflected in the productive block of the model: socio-personal, instrumental, general-scientific, general-professional, special-professional.

This component is connected with the environmental approach, which is based on the creation of a developing educational environment. This includes a person-oriented approach, which involves taking into account the individual characteristics of each student including their needs, preferences, goals and motives, the level of their cognitive activity and the level of the formed competencies in the pre-university preparation process.

The corrective component involves the systematic control of the knowledge, skills and abilities of students acquired in the process of studying natural science disciplines and determining the level of effectiveness of the educational process based on its results. This component is aimed at continuous improvement and correction of the forms, methods, means, and technologies of the educational process in order to increase the level of training of future specialists and achievement of sufficient / high levels of their professional competence.

The corrective component motivates the teacher to increase their own level of professional competence, monitoring of new pedagogical tendencies, study of innovative pedagogical experience, needs of society, and level of technological development of production.

The basic scientific approaches (competency-based, personal and activity, systematic, technological, environmental, acmeological) and principles (common-didactic: systematicity and subsequence, scientificity, accessibility, demonstrativeness, computerization, cooperation, emotionality, democratization, the relation of theory with practice, integration and specific: humanitarization and humanization, fundamentalization and politechnical education, professional orientation, self-organization) should be the basis for development of the model of formation of professional competence of future technicians of food production. These are reflected in the theoretical and methodological block of the model.

The ultimate goal of achieving the formation of an appropriate level of professional competence seems possible under the condition of development and the implementation and

continuous improvement of the content of the education system. The content of the preparation of future technicians of food production reflects the content-related block of the model, which provides a foundational knowledge of fundamental natural science disciplines. These include inorganic chemistry, organic chemistry, physical and colloidal chemistry, chemistry (general education course), biochemistry, biology, analytical chemistry, microbiology and physiology, and principles of ecology. The content-related block also includes knowledge and ability to apply the acquired theoretical and practical experience in the process of future professional and practical social activities. The integrative course "Food Chemistry" has the particular importance in the block, which will allow realizing the principles of professional orientation, fundamentalization and polytechnical education as much as possible.

The organizational and procedural block includes the technology of implementation of the model, the stages of the organization of educational and cognitive activities of students, and a set of defined forms, methods and means of training.

The efficient block characterizes the degree of achievement of the set goal. That is, it reflects the components of the professional competence of future technicians of food production (personal, cognitive, practical-active, reflective and estimate)**,** criteria (motivational and value-based, informative, functional and practical, personal and reflective), levels of its formation (low, medium, sufficient, high) and result (formed professional competence of future technicians of food production).

It provides a purposeful systematic diagnostic and identification of the main areas for increasing the level of students' professional competence development. This component illustrates the success of the designed model.

The formation of the professional competence of future specialists will be effective due to the implementation of the following pedagogical conditions: 1) modernization of the content of professional education; 2) the optimal ratio of general education and professional training of specialists; 3) strengthening of the professional orientation of natural science disciplines; 4) integration of natural-science and professional training; 5) providing motivation for future professional activity. These pedagogical conditions were determined by utilising the factor analysis method. Pedagogical conditions have a cross-cutting nature in the designed model; they provide its practical implementation.

The effectiveness of the study's model was tested by its implementation into the educational institutions of Zhytomyr Cooperative College of Business and Law and structural units of Kyiv National Trade and Economy University (Zhytomyr Trade and Economy College, Kyiv Trade and Economy College, Vinnytsia Trade and Economy College). Experimental work was carried out in accordance with the designed program, the aim of which was to implement the preparatory, summative**,** and formative stages.

At the preparatory stage, the purpose and objectives of the research, its consistency, content details and methodical and instrumental support were determined. At the summative stage of the experiment, the state of formation of the professional competence of future specialists in the production of food products in the process of studying natural science disciplines has been analyzed. The obtained results show the imperfection of the process of forming of professional competence, a low level of motivation to study natural science disciplines, the unconsciousness of value of the natural component for future professional activity, and inadequacy in determining the level of formation of own competencies acquired during the study of chemical and biological disciplines. The statistical analysis of the data showed that the professional competence in the majority of students is formed at low (33.8 %) and medium (34.6 %) levels.

In order to increase the efficiency of the process of forming the professional competence of future technicians of food production, a task-oriented impact on all its components (personal, cognitive, practical-active, reflective and estimate) is provided, which ensures the development

of all defined groups of competencies and the components of professional competence (socio-personal, general scientific, instrumental, general-professional, special-professional).

With this end in view, an experimental integrative technology has been developed [3: 177–178], which was implemented at the formative stage and implied the organization of educational process on the basis of content and the methodological, organizational and practical integration of natural and professional disciplines. The practical implementation of the conceptual foundations of the technology was carried out at the preparatory-organizational, procedural-methodical and productively-evaluative stages and consisted of the implementation of an optional course "Food Chemistry". This course was used by students and teachers of natural and professional disciplines of the manual "Organic Chemistry", which allowed for an increase in the efficiency of training of future specialists in the production of food products.

It has been proven that the professional orientation of fundamental natural science disciplines significantly increased the motivation to study professional disciplines and helped to realize the importance of the natural component in future professional activities. The increase of the proportion of active and interactive forms and methods of work, the improvement of the methodological support of the educational process contributed to the intensification of cognitive activity of students, and prompted to the active professional-creative search.

The results of the formative stage of the experiment, which were measured in relative periodicities, indicated an increase in the level of the formation of professional competence in such criteria as a motivational and value-based (0.73 in comparison with 0.53), informative (0.73 in comparison with 0.52), and functional (0.75 in comparison with 0, 54). Naturally, the positive dynamics of the formation of all defined groups of competencies are traced. In particular, the number of students of the experimental group with high and sufficient levels of the formation of socio-personal competences increased from 26.8 % to 29.7 % and 15.4 % to 20.8 % respectively; general scientific – from 20.7 % to 34.7 % and from 13.3 % to 21.7 %; instrumental – from 23.9 % to 33.8 % and 14.4 % to 22.0 %; general-professional – from 22,0 % to 37,3 % and 14,8 % to 26,9 %; special-professional – from 19,9 % to 37,2 % and from 11,8 % to 23,1 %, which resulted in an increase in the general level of the formation of professional competence by 20,7 %, a decrease in the low level – by 11,8 % (Table 1).

Table 1

Comparative table of the formation of professional competence of future technicians of food production in the process of studying natural science disciplines (%)

№ s/n	The level of formedness of the professional competence	Before experiment				After experiment			
		CG		EG		CG		EG	
		Number of per.	%	Number of per.	%	Number of per.	%	Number of per.	%
1	Low	39	34,0	37	31,2	34	30,1	24	19,9
2	Medium	39	34,0	38	32,0	38	33,0	27	22,5
3	Sufficient	23	20,0	28	22,8	26	22,6	41	34,6
4	High	13	12,0	17	14,0	16	14,3	28	23,0

The reliability of the obtained findings was verified using the statistical t-criterion of Stiudent's distribution ($p = 0.95$, α not exceeding 0.05).

Therefore, the developed model for the formation of professional competence of future technicians in the production of food products in the process of studying natural science disciplines is a complex structural -functional system that can increase the effectiveness of training specialists in this specialty. The proposed model provides an opportunity to consider the professional training of future specialists as an integral process where the purposeful interaction of teachers and students, the educational environment with the whole complex of pedagogical conditions are carried out.

Conclusions and perspectives of further study of the problem. The prospects for further research will consist of analytical and procedural work on the selection and differentiation of the content of natural science disciplines in the preparation of Junior Bachelors and Bachelors in colleges in the specialty "Food Technologies".

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Received: December 27, 2018
Accepted: March 12, 2019

Модель формування професійної компетентності майбутніх спеціалістів харчових технологій у процесі вивчення природничих дисциплін у коледжі.

У статті констатовано необхідність перебудови освітнього процесу з урахуванням сучасних вимог до рівня сформованості професійної компетентності випускників вишів. Обґрунтовано модель формування професійної компетентності майбутніх техніків-технологів виробництва харчової продукції в процесі вивчення природничих дисциплін. Описано структуру моделі, яка складається з п'яти блоків: 1) цільовий; 2) теоретико-методологічний; 3) змістовий; 4) організаційно-процесуальний; 5) оцінно-результативний та висвітлено взаємозв'язки між ними. Визначено значення провідних педагогічних умов у процесі формування професійної компетентності. Розкрито сутність дефініцій "модель", "моделювання" та доцільність методу моделювання як засобу вивчення педагогічних процесів і явищ. Констатовано, що підвищення рівня сформованості професійної компетентності майбутніх спеціалістів з виробництва харчової продукції буде залежати від розвитку усіх її компонентів (особистісного, когнітивного, діяльнісного, рефлексивно-оцінного). Представлено результати експериментальної перевірки ефективності розробленої моделі в освітній процес коледжів шляхом упровадження авторської технології, що ґрунтувалася на інтеграції природничих та фахових дисциплін (змістовій, методичній, організаційній, практичній). Доведено, що професійне спрямування фундаментальних природничих дисциплін значно підвищило мотивацію до вивчення фахових дисциплін, сприяло усвідомленню значення природничої складової у майбутній професійній діяльності. Збільшення частки активних та інтерактивних форм і методів роботи, удосконалення науково-методичного забезпечення освітнього процесу сприяло активізації пізнавальної діяльності студентів, спонукало до активного професійно-творчого пошуку.

Ключові слова: *модель, моделювання, професійна компетентність, педагогічний експеримент, інтеграція природничих та фахових дисциплін.*