РОЗДІЛ 4. ОПТИМІЗАЦІЯ НАВЧАННЯ ДИСЦИПЛІН ПРИРОДНИЧО-МАТЕМАТИЧНОГО ЦИКЛУ ЗАСОБАМИ ІНФОРМАЦІЙНИХ ТЕХНОЛОГІЙ

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INTERDISCIPLINARY AND MODELING COMPETENCIES AS THE COMPONENTS OF FUNDAMENTAL AND PROFESSIONAL TRAINING OF THE ELECTROMECHANICS BACHELORS

The purpose of this research is to identify and substantiate interdisciplinary competencies and competencies in modeling as components of fundamental and professional training of the electromechanics bachelors. The leading tendencies of professional training of electromechanics bachelors in Ukraine are revealed: transition to competence-based training standards; the development of integrated learning programs based on the National Qualifications Framework; development of professional standards of training specialists in the field of mechatronics for the metallurgical and mining industry; ensuring continuous training and retraining of electrical engineers based on the use of modern ICT. An analysis of previous researches has shown that fundamental learning in mathematics, physics, computer science and ICT are the necessary components of the professional training of electromechanics technicians and electromechanics bachelors. The results of the research made it possible to determine interdisciplinary competence and competence in modeling, the formation of which helps to bridge the gap between the basic natural-mathematical block and the mobile technological block of vocational training of electromechanics bachelors: interdisciplinary competencies (intellectual competence, competence in project development, constant competence of self-education, independent work and creative thinking, ICT competences and competences in fundamental sciences), and competencies in modeling (competence in applied mathematics, use of different methods of presentation of models and competence in modeling of electromechanical systems). It is shown that mobile Internet devices are a promising tool for learning electromechanics bachelors – mobile multimedia devices providing wireless access to information and communication Internet services for the collection, systematization, storage, processing, transmission, presentation of all kinds of messages and data.

Keywords: *professional training, electromechanics bachelors, professional competencies of the electromechanics bachelors, interdisciplinary competencies, modeling competencies, intellectual competence, project development competence, continuous self-improvement competence.*

Formulation of problem. The professional training of electromechanics bachelors in higher educational institutions of Ukraine is carried out in 38 universities of Ukraine within the within knowledge sector 14 – electrical engineering. The direction of "Electromechanics" training is one of the few, according to which in 2012 the excess of the number entrants enrolled on the first year the volume of the state order (more than 10% more than the state orders volume). The related direction "Electrical engineering and electrotechnology" is also state and socially significant. According to the Resolution of the Cabinet of Ministers of Ukraine No. 266 dated April 29, 2015, these directions are united in specialty 141 "Electricity, electrical engineering and electromechanics".

The components of the sectoral standard of higher education in Ukraine (educational-professional program [15] and educational qualification characteristic [16] and ways of diagnosing the quality of higher education) are approved by the Order of the Ministry of Education and Science of Ukraine dated November 12, 2014, No. 1308. According to Educational qualification characteristics of the bachelor of electromechanics, graduates of the bachelor's degree have the qualification 2149.2 – junior electrical engineer with a generalized object of activity – "electric machines and apparatuses, electric drives, electric transport, electromechanics and systems, complexes, devices and equipment" [15, p. 6]. According to [1], electromechanical engineers have to be prepared for the development, maintenance and installation of automated, servomechanical and other electromechanical systems, in particular testing of prototype equipment, production and operational tests, system analysis, maintenance procedures, reports preparation.

The generality of training specialists in specialty 141 "Electricity, electrical engineering and electromechanics" requires the identification and justification of their general competencies, in particular – interdisciplinary and modeling competencies.

Analysis of basic researches. Despite the lack of a holistic study of the process of training engineers-electromechanics in domestic and foreign works, some components of this process were considered in a number of theses devoted to the training of electricians. Thus, the level of the formation of professional competence of masters of electrical engineering direction Galina Iu. Dmukh [3] determines the degree of development of the following competencies: research (the collection, analysis, processing and systematization of scientific and technical information, the ability to participate in all phases of research, the ability to use the achievements of science and technology, advanced national and foreign experience); operational (ability to carry out examination of technical documentation, supervision and control over the state of technological processes and operation of equipment, ability to effectively use natural resources, materials and energy); design (the ability to carry out a comprehensive technical and economic analysis, knowledge of methods for conducting technical calculations and determination of the economic efficiency of research and development, knowledge of the principles of work, technical, design features of the developed and used technical means); production-technological (knowledge of technology for the design, production and operation of products and facilities for technological equipment); organizational and managerial (interaction with specialists of the related profile). From the experience of masters of electromechanics at the Royal Institute of Technology (Sweden), Mats Hanson came to the conclusion that the most useful project in the teaching of mechatronics is the design-oriented approach [8].

The separation of the competences of the future specialist in the electromechanical profile in the process of simulation of professional training, according to Natalia P. Motorina [22], should be carried out on the basis of a specialist's model, the components of which are:

– identification of a range of main tasks solved by a modern electromechanician (model of activity);

– definition of the complex necessary for a specialist knowledge, skills and professional skills based on the model of activity (model of training);

– clarification of the necessary professional qualities of the specialist (model of personal qualities);

– preparation for the acquisition of perspective directions of development for this specialty, based on the forecast of its development for the next 15-20 years (model of the prospects of the specialty).

According to the results of modeling, the design and implementation of the profile education system (Sergei N. Kashkin [10]), vocational training and retraining of specialists on the basis of the theory of continuous multi-level vocational education is carried out. Sergei A. Pchela [24] established the following pedagogical regularities of continuity, characteristic for the continuous training of specialists: structural, procedural and content continuity determine the content of educational programs, the content and quality of teaching and methodological provision of training, the level and quality of material and technical provision of training, the

order and sequence of theoretical and practical training, the choice of forms and methods of teaching, types of educational activities and methods for diagnosing the level of professional training of specialists, the level of per training, training of teachers for the implementation of quality education programs. Elena A. Dragunova [4] notes that in this approach, the quality of training can be improved, in particular, through the use of modern software for distance learning and the possibilities of Internet technologies.

The purpose of continuous multi-level vocational education is the training of skilled professionals capable of navigating in ever-changing reality, mastering new modern technologies, implementing them in practice and successfully mastering fundamentally new areas and activities. Successfully self-realizing and feeling comfortable in a modern society, as well as ensuring its sustainable development will be able professionals who can mobilize themselves to improve themselves and transform their professional reality in accordance with the requirements of time and modern society. Tatiana B. Kotmakova [11] defines one of the main professional characteristics of the future specialist, which increases his competitiveness in the labor market – personal mobility – as an integrative quality of the future specialist, which manifests itself in the formed motivation to study, the ability to work in an effective way communication and allows you to stay in the process of active creative self-development.

Roman M. Sobko offers the following principles for the integrative use of ICT facilities in the training of students of electrical and electromechanical specialties, the main of which are the principles: the purposeful use of ICT tools in the professional training of specialists, which provides methodological, psychological, pedagogical and methodological substantiation of the content of ICT education; professional orientation of ICT training; continuity of use of ICT at all stages of vocational training; the degree and systematic formation of the ITC competence of a future specialist; awareness of the use of ICTs in solving professional problems; modeling of phenomena and processes of professional activity using ICT tools [24, p. 9-10].

The implementation of the latter two principles is possible provided that the future specialists prepare for the engineering experiment, which Raisa E. Mazhirina [14] defines as the property of the individual to manage the active cognitive process associated with the analysis of qualitative and quantitative characteristics of industrial objects. The training of future engineers for independent studies, including the development of techniques and techniques of experiment, is an essential part of the professional training of an engineer, whose production activity is associated with constant analysis and directed change of technical and natural systems. Considering that training in electromechanicians takes up a significant place in the field of quick-change engineering – electronic, – the use of ICT for modeling phenomena and processes of professional activity is necessary both in the process of professional training and in the process of professional activity, which necessitates the use of mobile modeling tools.

In the teaching of electrical engineering disciplines using ICT, Natalia P. Fiks [5] suggests using automated teaching and learning complexes, which include computer-based learning tools: textbooks, training generators, virtual laboratories, diagnostic tools and automated systems modeling. An example of such a complex is developed by Natalia G. Pankova [23] a complex of software and information support for the process of teaching electrical engineering disciplines, consisting of training manuals on the simulation and calculation of electrical circuits, methodological instructions for a laboratory workshop using ICT, programs, guidelines and control tasks for calculation and graphic works, test control system of success, system of training classes on the basis of ICT. The highest level of automation of the teaching-methodical complex is realized by Maksim A. Polskii [25] a combined didactic interactive program system that provides the organization of reproductive (recognition and reproduction) and productive heuristic educational and cognitive activity of students in the conditions of gradualness and completeness of studying with a closed directional automatic control. Among the conditions for the effectiveness of the organization of the educational process using such complexes, the researcher calls the high level of ICT competencies of teachers and students – in particular, the ability to work with universal software systems for modeling.

The general structure of training on simulation of bachelors of electromechanics defined by author in [18]. The structure includes the formation of fundamental, general professional and special professional competencies. In [20] the system of competencies in simulation is given; the components contribution of the system in its formation is researched in [17], the content of each competencies and the criteria for their formation is given in [21].

The aim of the article is to identify and substantiate interdisciplinary and modeling competencies as the components of fundamental and professional training of the bachelor in electromechanics.

Presentation of basic material of research. Giuzel S. Sagdeeva distinguishes the general intellectual qualities of the engineer's personality on the operation of electrical devices: ability to concentrate attention, ability to allocate essential features, ability to make a deliberate decision in a difficult technical situation, ability to manage and organize the work of personnel, ability to work with schemes and drawings, content in the memory of devices, models and devices, the ability to self-improvement [29, p. 9].

These qualities of an engineer's personality are the result of the formation of intellectual competence, the acquisition of which provides the basis for: the development of students of all components of the content of education; solving various life and professional problems; overcoming stereotypes and patterns of thinking; development of abilities to flexible variational perception and assessment of events occurring; reflection and consolidation of the experience of effective activity and success in a competitive environment. Sagdeeva's intellectual competence is defined as "metastability, which, by defining the degree of development by the subject of a certain domain, is characterized by a special type of organization of subject-specific knowledge and effective decision-making strategies in this subject area", distinguishing in its structure the following components: motivational, cognitive and metacognitive. The components of the motivational component are: readiness of students for self-education and development; the presence of motives that lead to cognitive activity; personality orientation. The cognitive component includes the ability to work with information: the ability to search, structure, transform, transfer information from one method of encoding to another; ability to make generalizations, conclusions, to highlight the main thing; the ability to compile cognitive schemes of mental activity, algorithms for solving problems. The metacognitive component is represented by the skills and abilities of intellectual self-management and self-organization: it is the ability to set goals, to plan, evaluate, control the cognitive activity, the ability to self-assess and reflexive analysis.

The conditions of intellectual competence of future electricians' development are:

1) simulation of intellectual and developmental situations in accordance with the psychological patterns and mechanisms of development of intellectual competence, taking into account the features of the future profession;

2) inclusion of students in various types of research activities aimed at the development and enrichment of invariant intellectual structures of the individual; improvement of student research methods based on the disclosure and formation of individual styles of intellectual activity;

3) development of psychological and pedagogical support of the process of training future electricians, which implements stimulating, diagnostic and corrective functions [29, p. 12-16].

The development of intellectual competence contributes to the formation of professional electrical thinking directed, according to Larisa N. Vishniakova, to the knowledge, understanding and transformation of electrotechnical objects, phenomena, processes and relations: "the essence of professional electrical engineering is manifested in its laws, namely, in natural conformance (based on the experience of human interaction with the biosphere, technosphere, society), cultural correspondence (associated with the mastery of general-professional and special knowledge and skills that are presented to the profession of social order of society) and the optimum combination of (relatively stable asymmetric harmony or complementarity) natural intuition of foresight and intellectual discipline in the performance of cognitive training and professional action" [33].

In its development, the professional electrical engineering of the student passes the following levels: elementary-empirical (zero), student, methodical, search. The transition of

professional electrical thinking from one level to another is associated with transitions in intellectual development: electrical engineering – electrotechnical education – professional competence – electrical engineering and technological culture.

Elena V. Shishchenko [30] and Aleksandr V. Gamov [7] considered the formation and development of professional competencies of students on the basis of interdisciplinary integration. According to Shishchenko, "the interdisciplinary integration of knowledge contributes to competent education, person-oriented technologies of learning, technology of developmental learning, project method, block-module training, contextual training, wide-profile training of specialists, adult learning technology, oriented to the perception and assimilation of knowledge, representing a coherent system; on the formation of skills to perform certain operations, tasks (including research, creative), associated with their professional activities" [30, p. 5]. Integration of electrical engineering disciplines (theoretical electrical engineering, electrical measurements, electronic equipment, electric machines, electric drive and converters) contributes to solving the contradiction between the fast-changing elemental base of electrical installations and aggregates, which are constantly complicated by their algorithmic structure and circuitry, on the one hand, and some conservatism of typical programs and tutorials that contain information on individual, often outdated, electrical installations, on the other hand [30, p. 7].

Uday Shanker Dixit takes notice that modern training engineers and electricians must be based on a top-down approach in which first provided a general idea of the final product, though not in great detail the form and then studied in detail subsystem system. This is due to the fact that such training involves many disciplines from different fields of engineering, so students should get an idea of how they will be integrated, the integration of different disciplines is an essential part mechatronics [2, p. 86; 19].

Gamov adds that "the integrative approach reveals the possibilities of developing professional competences on the basis of integration: general-professional, special disciplines and information technologies; technologies of problem and modular learning; methods of classical calculation and modeling of electrodynamic systems" [7, p. 11].

Increasing competitiveness requires mastering by the future specialist a set of knowledge, skills necessary to active creative professional development, continuous self-improvement and training during the work activity. Therefore, an important task for the professional training of future engineers-electromechanics is not so much the acquisition of ready-made knowledge, as mastering the methods of independent cognitive activity. Maiia H. Hordiienko [9] emphasizes that under accelerated accumulation and obsolescence professionally significant information mastering abilities and skills of independent work enables future professionals to be constantly informed of the latest technologies in his professional field, equips achievements of world science and practice: "At the same time, professionally competent electromechanicians must solve the urgent national problem of energy conservation through the use of various technologies driven which provide the necessary modes of operation of electromechanical complexes. These technologies are implemented by a variety of converters, soft starters, microprocessor management, etc., a significant number of which are produced by foreign companies. To explore and use the best international experience on the latest developments, future electromechanical engineer must be able to independently find the information you need to read it in a foreign language is to possess abilities and skills of independent work with foreign professional literature" [9, p. 3].

Under these conditions, the problem of forming skills and abilities of independent work for future engineers becomes of particular importance in order to ensure their adaptation, self-realization and self-education in the modern conditions of the information society and integration into the world community. The purposeful formation of skills and abilities of independent work of bachelors of electromechanics should begin with fundamental training, which is based on mathematics, physics and informatics.

Tetiana V. Krylova indicates that mathematics as a basis for the study of fundamental, general technical and special disciplines provides wide opportunities for the development of logical thinking, algorithmic culture, the formation of skills to establish causal relationships, to substantiate statements, to model, etc.: "if the methodical system of education Mathematics of bachelors of

electromechanics will take into account: the professional orientation of teaching mathematics; learning the beginnings of mathematical modeling in studying the general course of higher mathematics and special mathematical courses; solving problems of special content at the final stage of studying the disciplines of the mathematical cycle; methods, methods and means of activating the independent educational and cognitive activity of students in the study of mathematics; application of means of new information technology training in solving applied problems in the process of studying the general course of mathematics and special mathematical courses; level differentiation and individualization of teaching mathematics students of technical specialties; organization of independent work of students and control over its implementation, this will ensure the implementation of modern requirements for the mathematical preparation of students, promote their mental development, preparation for self-education in conditions of continuing education" [12].

Aleksandra N. Lavrenyna [13] proposes to fill a physics course by taking into account the profile of the training of future specialists, in particular, by analyzing the connections of the electrodynamics of the course in physics with the general technical discipline "Theoretical Foundations of Electrical Engineering" and the special discipline "Electric Machines" with the purpose of determining the role and places of physical knowledge in the system of vocational education of students of electrotechnical specialties.

Svetlana N. Potemkina [26] defined the general requirements for the professional training of an electrical engineer profile in the field of physics:

– *to know*: the principles of symmetry and conservation laws; about physical modeling;

– *to be able to* evaluate the numerical order of quantities characteristic of different sections of science;

– *to know and to be able to*: use the basic concepts, laws and models of mechanics, electricity and magnetism, oscillations and waves, quantum physics, statistical physics and thermodynamics; competently solve complex tasks, which include tasks by type of activity; use the methods of theoretical and experimental research in physics; apply standard rules for constructing and reading drawings and diagrams.

Interdisciplinary and modeling skills are used in all components of the fundamental and professional training of the bachelor of electromechanics. A striking example of the use of interdisciplinary modeling is the methodology for the formation of environmental knowledge of future engineers-electromechanics in the process of teaching special disciplines, the author of which developed Iryna O. Soloshych, points out that "the involvement of students in the solution of problem-oriented nature of simulated production situations using interactive and informational methods promotes the effective development of their professional interests, motivation to master the future specialty" [31, p. 12].

Considering the educational perspectives of applied mechatronics in the context of the integration of traditional topics of mechanical, electrical and computer engineering, C. J. Fraser et al. [6] offer the following sections of the curriculum: system engineering; microprocessor technology; digital electronics; digital and analog interfaces; digital communications; software development; Subordinate management of electric, pneumatic and hydraulic systems; the theory of automatic control.

Joshua Vaughan, Joel Fortgang, William Singhose, Jeffrey Donnell, and Thomas Kurfess [32] offer an integrative course "Creative Solutions and Design" aimed at the formation and development of students of mechatronic and communicative competences. The authors, emphasizing the importance of working in the team, note that team work can not equally develop students' competencies in all relevant fields, so they share work in accordance with their own comfort and abilities. In order to avoid this at the beginning of the course, it is expedient for each student to give an individual project, and in the second half of the course students are involved in team projects.

Yu Wang, Ying Yu, Chun Xie, Huiying Wang, and Xiao Feng [34] described 4 units of practical training at the CDHAW Center at Tongji University (China):

1) pre-training block includes study of the basics of mechanical, electrical and electronic engineering;

2) the block of fundamental training involves laboratory work, in which students check the laws of mechanics, physics, materials science, electrical engineering, etc.;

3) a block of specialized training involves laboratory work using controls, sensors, drives, controllers, microprocessors, etc.;

4) the unit of advanced training involves the student's independent work on projects.

The basic requirements for the professional training of specialists in electromechanics, formulated by the survey of employers, leads Maurice W. Roney [27, p. 26]:

1. Preparation should be fundamental: the emphasis should be more on the general principles of the work of electromechanical systems than on the application of these principles.

2. Communicative skills are extremely important in the work of electronics technicians, so they should be given special attention in the training program.

3. Study of the interconnection of electrical and mechanical elements of systems and devices should occupy a central place in specialized technical courses. Wherever possible, electrical and mechanical principles should be studied together, not alone.

4. Principles of electrical and mechanical physics are the main tools in the work of electronics technicians and any technical training should develop the skills of analytical thinking for which these tools are fundamental. In addition, there is an increasing need for techniques for working with new branches of application of other physical sciences such as: optical equipment, thermal power plants, hydraulic and pneumatic controls, as well as a wide range of measuring instruments.

To implement these requirements is proposed [27, p. 10]:

1. The main subjects that should be given the greatest attention are: physics – of the applied type (should not be classical physics); mathematics – through applied calculus; communications – drafting, sketching, composition, report writing; industrial electronics – regardless of the area in which the technician might be working, a good working knowledge of electronic devices, circuits, instruments and system is required.

2. The training program should also include material from the sections: light and optics; high vacuum techniques; engineering materials and stress analysis; chemistry, particularly from the viewpoint of corrosion; economics – as applied to industrial situations in design and application; mechanism and basics of mechanical design; transducers for various types of instrumentation; controllers and industrial control; fundamentals of computers.

3. It is very important to have an exact observation: by carefully observing, the technician must be able to analyze and synthesize. Although these two abilities may not develop intentionally in a particular course, they should be developed in all laboratory and classroom activities. Competence in these areas can be more important than just technical abilities.

4. The skills of manual labor with basic tools are also important.

5. If practicable, the training program should be no more than two years old.

In the training of electronics technicians, Roney proposes to follow a model that has a four-component structure (Fig. 1). In the center of the model – a student, on the development of the personality which must be sent all the efforts of pedagogues. To the teaching staff, Roney proposes a requirement for competence in more than one discipline in order to provide interdisciplinary connections and integration of academic disciplines [28, p. 20].

The development of the communicative competence of a future specialist should be supported by all pedagogues: the pedagogue "should not reduce his teaching function to writing mechanics. Instead, he must be able to distinguish the specific needs of students at each stage of the program. He must understand that without special communicative skills, the technician will be poorly trained to perform production functions" [28, p. 22].

But the most important requirement for pedagogues preparing future specialists in electromechanics, Roney considers "his production experience, which should be significant and as modern as possible. One of the main problems of teaching is the lagging content of training from the current state of development of production" [28, p. 22]. The prestige of the educational institution, according to the author, largely depends on the extent to which the qualifications of the pedagogues correspond to the current state of development of production.

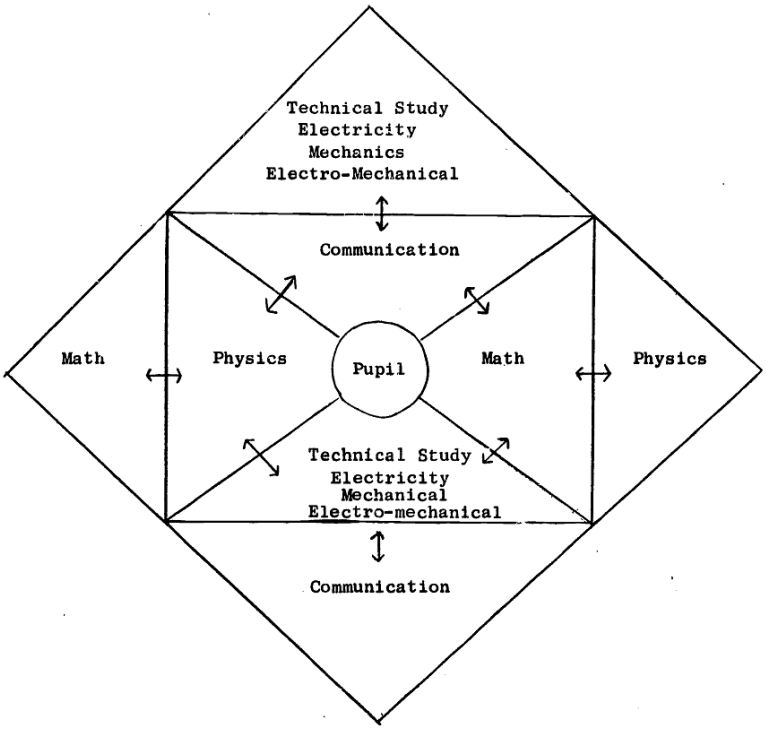

Figure 1. Technicians-electromechanics training model (by [28, p. 21])

The conclusion of this study and the prospects for further research:

1. The leading tendencies of professional training of bachelors of electromechanics in Ukraine are:

– transition to competence-oriented training standards;

– development of integrated training programs for «technician-electromechanic engineer-electromechanic» on the basis of the National Qualifications Framework;

– development of professional standards of training specialists in the field of mechatronics for the metallurgical and mining industry;

– ensuring continuous training and retraining of electrical engineers based on the use of modern ICT tools.

2. Summarizing the experience of fundamental and professional training of the bachelor in electromechanics in Ukraine and abroad makes it possible to determine their main:

– interdisciplinary competencies: intellectual competence, project development competence, continuous self-improvement competence, independent work and creative thinking, ICT competence, and competences in fundamental sciences;

– modeling competencies: applied mathematics competence, using the different ways of presenting models, and electromechanical system simulation competence.

3. The prospects for further scientific research on field of the modernization of the professional training of bachelors of electromechanics are seen in the development of a model and methodology for the use of mobile Internet devices in the training of modeling technical objects of bachelors of electromechanics.

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Модло Е. А. Междисциплинарные компетентности и компетентность в моделировании как составляющие профессиональной подготовки бакалавров электромеханики.

Целью данного исследования является определение и обоснование междисциплинарных компетентностей и компетентностей в моделировании как компонентов фундаментальной и профессиональной подготовки бакалавра электромеханики. Выявлены ведущие тенденции профессиональной подготовки бакалавров электромеханики в Украине: переход к компетентностного-ориентированным стандартам обучения; разработка интегрированных учебных программ на базе Национальной рамки квалификаций; разработка профессиональных стандартов подготовки специалистов в области мехатроники для металлургической и горнодобывающей промышленности; обеспечение непрерывной подготовки и переподготовки инженеров-электромехаников на основе использования современных ИКТ. Анализ предыдущих исследований показал, что необходимой составляющей профессиональной подготовки техников-электромехаников и бакалавров электромеханики является фундаментальная подготовка по математике, физике, информатике и информационно-коммуникационных технологий. Результаты исследования дали возможность определить междисциплинарные компетентности и компетентности в моделировании, формирование которых способствует преодолению разрыва между базовым естественно-математическим блоком и мобильным технологическим блоком профессионально-практической подготовки бакалавров электромеханики. Показано, что перспективным средством обучения бакалавров электромеханики моделирование технических объектов являются мобильные Интернет-устройства.

Ключевые слова: *профессиональная подготовка, бакалавры электромеханики, профессиональные компетентности бакалавров электромеханики, междисциплинарные компетентности, компетентности в моделировании, интеллектуальная*

компетентность, компетентность в разработке проектов, самообразовательная компетентность.

Модло Є. О. Міждисциплінарні компетентності та компетентності з моделювання як складові професійної підготовки бакалаврів електромеханіки.

Метою даного дослідження є визначення та обґрунтування міждисциплінарних компетенцій та компетенцій у моделюванні як компонентів фундаментальної та професійної підготовки бакалавра електромеханіки за новими стандартами вищої освіти. Виявлені провідні тенденції професійної підготовки бакалаврів електромеханіки в Україні: перехід до компетентісно-орієнтованих стандартів навчання; розробка інтегрованих навчальних програм на базі Національної рамки кваліфікацій; розробка професійних стандартів підготовки фахівців у галузі мехатроніки для металургійної та гірничодобувної промисловості; забезпечення безперервної підготовки та перепідготовки інженерів-електромеханіків на основі використання сучасних інструментів ІКТ. Проведений аналіз попередніх досліджень показав, що необхідною складовою професійної підготовки техніків-електромеханіків та бакалаврів електромеханіки є фундаментальна підготовка з математики, фізики, інформатики та інформаційно-комунікаційних технологій. Результати дослідження надали можливість визначити та обґрунтувати компетенції, формування яких сприяє подоланню розриву між фундаментальним природничо-математичним блоком та мобільним технологічним блоком професійно-практичної підготовки бакалаврів електромеханіки: міждисциплінарні компетенції (інтелектуальна компетенція, компетентність у розвитку проекту, постійна компетенція самоосвіти, самостійна робота та творче мислення, компетенція ІКТ та компетенції в фундаментальних науках) та компетенції з моделювання (компетенція у прикладній математиці, використання різних способів подання моделей та компетенція у моделювання електромеханічних систем). Показано, що перспективним засобом навчання бакалаврів електромеханіки моделювання технічних об'єктів є мобільні Інтернет-пристрої – мультимедійні мобільні пристрої, що надають бездротовий доступ до інформаційно-комунікаційних Інтернет-послуг зі збирання, систематизації, зберігання, опрацювання, передавання, подання всеможливих повідомлень і даних.

Ключові слова: *професійна підготовка, бакалаври електромеханіки, професійні компетентності бакалаврів електромеханіки, міждисциплінарні компетентності, компетентності з моделювання, інтелектуальна компетентність, компетентність із розробки проектів, самоосвітня компетентність.*

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ЗАСТОСУВАННЯ СЕРВІСУ LEARNINGAPPS НА УРОКАХ ХІМІЇ ПІД ЧАС ВИВЧЕННЯ ТЕМИ «ВОДА»

Мета цієї статті полягає в теоретичному обґрунтуванні та розробці методики контролю навчальних досягнень семикласників з теми «Вода» з використанням онлайн сервісу LearningApps та її експериментальна перевірка. Для контролю знань, умінь та навичок учнів на уроці вчителям можна використовувати інтерактивні завдання, створені за допомогою сервісу LearningApps. Такі завдання дають змогу в ігровій формі засвоїти та перевірити рівень навчальних досягнень школярів. Важливо, що цей сервіс дозволяє публікувати свої вправи та користуватися вже створеними вправами інших учителів. У статті проаналізовано науковий доробок педагогів-практиків і роботи теоретичного