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METHODOLOGICAL APPROACHES TO THE PROBLEM OF FORMING PROFESSIONAL COMPETENCE OF FUTURE BACHELORS IN ELECTRONICS IN HIGHER EDUCATION INSTITUTIONS

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In this research, the author delves into the results of a thorough study and analysis of methodological approaches to shaping the professional competence of future electronics bachelor's students in higher education institutions. The focus is on an integrated approach to learning, combining technical components and interdisciplinary connections, and fostering the holistic development of students. This allows for a nuanced portrayal of the multifaceted process of shaping professional competence in the current realities of higher education. The author presents an analysis of scientific inquiries directly or indirectly related to the issue of forming professional competence in future electronics bachelor's students in higher education institutions. The inadequacy of the study on the chosen issue is noted, necessitating a systematic investigation and the identification of specific measures for optimizing the process of shaping professional competence in electronics. The research also highlights the peculiarities of the impact of military conflict conditions on the process of forming professional competence in future electronics bachelor's students in Ukrainian higher education institutions. Possible limitations in access to educational resources are analyzed, emphasizing the need for adjusting educational programs in the context of wartime conflict. The focus is directed towards analyzing adaptation strategies of higher education to new realities and developing effective methods to ensure safety and quality learning during military actions. The study underscores the necessity of developing innovative teaching approaches, flexibility in higher education responses to global changes, and establishing effective collaboration with the industry. Overall, the research indicates the relevance of combining technical and humanitarian aspects in the higher education of future electronics professionals and reveals prospects for educational institutions in shaping highly qualified experts capable of meeting the challenges of the contemporary technological world

Keywords: *interdisciplinarity, integrated approach, humanities competence, distance learning, technological progress, adaptation*

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1. Introduction

Modern higher education in the field of electronics requires not only meaningful technical knowledge, but also the development of students' readiness to work in interdisciplinary teams and to solve complex tasks in conditions of rapid technological changes. In this context, the issue of forming the professional competence of future bachelors in electronics becomes a relevant and important task for higher education. Since the outlined problems are not sufficiently represented in the scientific space, it is worth starting work on the study of methodological approaches to the problem of the formation of professional competence among students choosing the direction of electronics in institutions of higher education.

2. Literary review

A. Kolomiets notes that in higher education systems, training of specialists is currently carried out mainly based on today's requirements, without taking into account future prospects. This does not ensure full training of future specialists for rapidly changing production conditions. The fundamental nature of the content of the training of specialists in the modern dynamic conditions of the modernization of Ukrainian society orients the student to such training, which would enable him/her to form, first of all, the fundamental foundations of systemically structured knowledge, to acquire the ability to independently search for the latest specific, relevant knowledge, maximally adapted to the requirements of his/her professional activity [1].

K. Ilnitska emphasizes that electronics is one of the major directions of modern fundamental science. It contains all the main features of modern physics and is closely related to various branches of science and technology, modern technologies, production, health care, media and culture of modern civilized society; almost all modern household appliances are "saturated" with electronics. As for the scientific aspect, it is worth noting that radio physics, the elementary base of which is electronics, serves as an important source of knowledge about the surrounding world. The technical aspect of this branch of physics can be evidenced by the discoveries that became the basis of a large number of unique technical devices that, to a certain extent, have become defining attributes of the life of modern society.

The humanitarian aspect of this cycle of sciences should be associated with the fact that they make a significant contribution to the formation of students' broad ideas about the modern scientific picture of the world, thereby occupying an important place in the process of accumulating the intellectual potential of all people [2].

The professional competence of future specialists is a complex multifactorial personal formation that includes a system of scientific objective profile knowledge and skills of a specialist, the ability to adapt them to activities, value orientations, motives for activity, integrated indicators of culture (language, style, communication, attitude), as well as availability of sustainable readiness for professional development.

V. Tatarchuk emphasizes that the professional competence of future specialists in the field of electronics is largely determined by the ability to imagine a technical object and the principles of its operation according to the available design documentation. At the same time, he/she should be able to use a graphic image in the process of communication, as well as be socially and professionally mobile in the conditions of a postmodern manufactured society, using graphic tools and methods, computer graphic programs, etc. [3].

It is worth emphasizing the importance of social and professional mobility of specialists. This requires students not only to have technical skills, but also to be able to adapt to changes in the social and technological environment, using graphic programs and other modern tools.

According to A. Kapiton, the selection in the structure of professional competence of future specialists of its separate informational and computing component, which allows reflecting one of the components of personal development in the chosen profession, is insufficiently researched in the space of professional education. Acquisition of knowledge by students of higher education independently and in an educational institution during the entire period of study contributes to the formation of the professional intelligence of future specialists, forms their professional readiness for future activities. The system of acquired knowledge and skills of higher education students provides an opportunity for professional development in the information environment. The analysis of the multi-component structure of professional competence of future specialists provides an opportunity to characterize and supplement the structure of professional competence of specialists, thanks to the addition of the structure of special competences of future specialists by isolating its informational and computing component [4].

Complementing the structure of special competencies of future bachelors with an information and computing aspect may include the development of skills in working with modern information technologies, programming, analysis and data processing. This is important in the context of rapid technological development and the growing importance of the digital environment in the modern electronic sector. The analysis of the information and computing component of professional competence allows not only to determine modern requirements for specialists, but also to consider them in educational programs. This will allow students to more effectively implement modern technologies and innovations in their professional development.

Analysis of the information and computing component of professional competence becomes key to determining modern requirements for specialists in the field of electronics. Taking into account these requirements in educational programs will allow effective implementing of modern technologies and innovations in their own professional development, which is critical for their success in a dynamic technological environment.

The combination of different methodologies can create a multifaceted and effective approach to the formation of professional competence. Such an integrated approach includes components of competence, problem-oriented and research approaches [5]:

1. The competence component involves the development of specific skills in the field of electronics through practical tasks and laboratory work.

2. The problem-oriented component is a presentation to students of real challenges and tasks that may arise in modern electronics. The solution of these problems occurs in the process of learning.

3. The research component is focused on promoting student participation in scientific research in the field of electronics. This may include working on new technologies or researching market trends.

4. The integrated component involves connecting the study of electronics with other fields of knowledge, such as social, economic or environmental, to form a holistic understanding of the subject.

5. The communicative component is aimed at developing communication skills, in particular the ability to clearly express ideas and communicate in a team [6].

This combination allows students not only to acquire technical knowledge, but also to develop critical thinking, creativity and collaboration – everything necessary for a successful professional activity in the field of electronics.

At the same time, insufficient attention is paid to the analysis of methodological approaches to the problem of the formation of professional competence of future bachelors in electronics in higher education institutions of Ukraine.

3. The purpose and objectives of the research

The purpose of this work is to research methodological approaches to the problem of forming the professional competence of future bachelors in electronics in higher education institutions.

To achieve the goal, it is necessary to solve the following tasks:

1. To analyze modern approaches to the problem of formation of the professional competence of future bachelors in electronics of higher education institutions.

2. To determine the positive and negative aspects of the implementation of the process of formation of the professional competence of future bachelors in electronics in higher education institutions.

3. To develop recommendations for teachers regarding the optimization of the method of formation of professional competence of future bachelors in electronics in higher education institutions.

4. Materials and methods

In the process of scientific research, the following methods were used: analysis and systematization – dur-

ing the review of scientific articles, reports of scientific conferences, educational and methodological manuals, which present reviews and descriptions of issues related to methodological approaches to the problem of the formation of professional competence of future bachelors in electronics in institutions of higher education.

For collection of necessary information, the analysis of scientific literature was conducted on questions of a professional competence and methodological approaches to forming it. Among information generators, scientific databases of Google Scholar, Clarivate, Web of Science, are possible. During research there were the taken into account results of realization of the expert questioning among teachers and students in industry of electronics for determination of their idea about a professional competence and ways of its development. The comparative analysis of the programs of studies was also carried out from electronics in different establishments of higher education for the exposure of the best practices in forming of professional competence.

5. Research results and their discussion

Let us consider the pedagogical conditions, the implementation of which is aimed at forming the professional competence of future bachelors in electronics in higher education institutions [7]:

The first pedagogical condition provided for the development and assimilation by students of the integrated content of professional training, which combines fundamental-technical, specialized-professional and professional-practical blocks of disciplines, which contributes to the formation of general professional and specialized components of professional competence. Pedagogical conditions are aimed at ensuring practical orientation of professional training disciplines by supplementing their content with topics that implement interdisciplinary connections and are related to the professional activities of future bachelors in electronics; interdisciplinary integration of knowledge through development, and use and assimilation by students of the integrated content of the educational program.

The second pedagogical condition involves the development and inclusion in the preparation process of complex professionally oriented tasks that allow for the simultaneous formation of instrumental, general professional and specialized components of professional competence. Within the limits of the given pedagogical conditions, the formation of students' abilities, skills and the acquisition of experience in professional activities in electronics should take place by solving complex professionally oriented tasks of various levels of complexity. Development of a set of tasks should include the use of integrated content of professional training; different level of complexity of tasks; and creation of an algorithm for their solution and specification of methodological conditions for their application in the educational process.

The third pedagogical condition is the use of a complex of interactive methods and group forms of training, which ensure the development of both professionally oriented and socio-personal components of the professional competence of future bachelors in electronics. It involves the improvement of both professional skills and abilities, as well as the development of professionally important personality qualities and motivation to the professional activities of future bachelors in electronics based on the application of methods of modeling production processes and situations (case methods), work in small groups, the project method, cooperative learning, working out debatable issues, collective-group learning, situational-problem method, and situational modeling [8].

The outlined integrated approach can be practically implemented in the process of studying electronics for future bachelors, if the implementation of the following steps is taken into account:

1. Adjusting the content of the educational course in electronics by including practical laboratory works that allow students to apply and develop specific technical skills.

2. Implementation of project-oriented tasks: creation of projects, aimed at solving real problems in the field of electronics. For example, the development of devices for energy efficiency or innovative solutions to improve consumer electronics.

3. Systematic conducting of scientific research is implemented by inviting students to join scientific groups or conducting their own research in electronics. This may include analyzing trends in technology development or researching new methods.

4. Structured integration with other disciplines involves collaboration with teachers of other subjects to create projects that combine knowledge of electronics with social, economic or environmental dimensions.

5. The implementation of creative communication tasks includes the organization of discussions, presentations and group projects for the development of communication skills of future bachelors in electronics.

This approach promotes the fuller development of future electronics undergraduates by helping them understand how their technical skills affect society and how they can use their knowledge to solve real-world problems.

When implementing an integrated approach to learning electronics, some problematic aspects may arise. Let us consider several of them and possible ways to solve them:

Problem: insufficient number of laboratory premises, equipment and funds for the implementation of practical tasks and research.

Ways of solving: engaging in cooperation with industrial partners to provide equipment, applying to grant programs or finding innovative solutions for using available resources.

Problem: Excessive workload and lack of coordination between different subjects.

Solutions: organization of regular meetings between teachers to exchange ideas and create a unified concept of education. Implementation of programs of cooperation and exchange of experience.

Problem: students' inability to understand the importance of an integrated approach or loss of interest due to the large volume of tasks.

Solutions: use of interesting and relevant projects, involvement of students in the decision-making process and taking into account their interests in the formulation of tasks.

Problem: students may have difficulties in expressing their own ideas and communicating in a team.

Solutions: implementation of communication trainings, creation of conditions for group work and presentations.

Problem: teachers may find it difficult to implement new methods due to a lack of motivation or recognition.

Solutions: establishment of a system of incentives and recognition of the contribution of teachers to the improvement of the educational process, the possibility of participation in conferences and professional events.

These solutions can help overcome difficulties and ensure the effective implementation of an integrated approach to electronics education.

We will present methodological recommendations for teachers who are focused on the highly effective implementation of an integrated approach to learning electronics:

1. Development of an integrated course. It is appropriate to create a holistic educational course that integrates content from the various disciplines students are studying and to identify key themes and issues that can be integrated.

2. Planning of joint projects. To develop a system of projects that include elements of electronics and other disciplines and provide opportunities for students to work together on tasks and solve complex problems [9].

3. Organization of interdisciplinary meetings. To hold regular meetings with teachers of other disciplines to discuss opportunities for cooperation and joint planning of the educational process.

4. Involvement in scientific research. To promote the participation of students in scientific research in the field of electronics and involve them in working on current problems of the field [10].

5. Providing a feedback form. To provide a means of assessment and feedback on students' performance in the study of electronics and their development in other aspects.

6. Cooperation with industry. To implement opportunities for cooperation with industrial partners to provide students with access to modern equipment and real tasks.

7. Stimulation of initiatives. To promote students' independence and initiative and allow them to choose topics for project research.

8. Creation of a favorable environment. To create an atmosphere of interaction and support among teachers and students to stimulate integration and collective development.

These guidelines can serve as a starting point for teachers who wish to effectively implement an integrated approach in teaching electronics. The application of these principles will contribute to the fuller and deeper development of students in the field of electronics.

The results, obtained from the implementation of an integrated approach to the teaching of electronics, can have significant consequences for students, teachers and the industry in general. This will be reflected in the following:

1. Broader understanding of the industry. Future bachelors in electronics will gain a more complete and deeper understanding of electronics because their studies will be aimed at interacting with other fields, such as social sciences, economics and ecology.

2. Development of integrated skills. Future electronics bachelors will develop problem-solving, communication, and collaboration skills that will enable them to work successfully in interdisciplinary teams and real-world workflow situations.

3. Practical application of knowledge. Students' ability to apply their knowledge in hands-on projects and real-world scenarios will help prepare them for a successful career in electronics.

4. Increasing competitiveness in the labor market. Future bachelors in electronics studying in an integrated format may become more attractive in the labor market, as they will have a wider range of skills and abilities.

5. Stimulation of innovations. Involvement of future bachelors in electronics in scientific research and projects will contribute to the development of innovations in the field of electronics, contributing to the emergence of new technologies and solutions.

6. Increasing student motivation. Involving students in interesting and important projects can increase their motivation and interest in their own learning.

7. Strengthening the role of the teacher as a mentor. Teachers who implement an integrated approach can become mentors who help students understand the connection between different fields and develop their talents and interests.

Therefore, the obtained results can help students to be ready for the challenges of the modern world, where the integration and interaction of different fields of knowledge are becoming more and more important.

The research in the field of methodological aspects of the formation of professional competence of future bachelors in electronics, in particular, using an integrated approach, opens up a wide range of opportunities for further research. Thus, the evaluation of the effectiveness of the integrated approach involves conducting a systematic evaluation of the results of the implementation of the integrated approach in order to find out its effectiveness and impact on the professional training of students. The study and development of new educational methods and strategies is aimed at improving integrated learning in the field of electronics. Conducting experimental teaching programs is important for determining optimal methods and strategies for implementing an integrated approach. These areas can contribute to the further development of the educational process in the field of electronics, ensuring the compliance of training with the requirements of the modern world and the development of competitive professionals.

Limitations of the study. The research may not take into account the variety of methods and approaches to the formation of professional competence that exist in various institutions of higher education. Further research materials should also take into account the opinions and experiences of employers, who are key stakeholders in building the professional competence of electronics bachelors. We will focus on these aspects in further research materials.

Prospects for further research. Further research may focus on comparative analysis of the effectiveness of different methods and approaches using experimental designs or meta-analysis techniques. This will help determine which methods and approaches give the best results in developing the professional competence of future electronics bachelors.

6. Conclusions

1. The results of the study indicate the importance of using an integrated approach in teaching electronics. This approach contributes to the fuller development of students, the deepening of their knowledge and the development of interdisciplinary skills. Martial law conditions affect security, access to resources, and changes in educational programs. The educational process should be flexible, adaptive and able to respond to modern challenges.

2. Research in this area opens new horizons for the development of education in the field of electronics. Cooperation with industrial partners allows for the integration of practical experience and modern industry requirements into educational programs. This is important to ensure the relevance of the knowledge and skills students receive and the readiness of graduates to implement them in real professional scenarios. Collaborating with the authorities is necessary to ensure financial support, create a favorable legislative environment and regulate educational initiatives. Ensuring access to resources for students and researchers, including laboratory equipment, software, and other infrastructure capabilities, is also important. But the process of forming the professional competence of future bachelors in electronics requires significant resources, including funding, material and technical support, and qualified personnel. Also, assessing the level of formation of professional competence is a difficult task that requires the development of new methods and tools.

3. Optimizing the methodology for developing the professional competence of future electronics bachelors in higher education institutions requires comprehensive and systematic efforts on the part of teachers. The use of innovative teaching methods, cooperation with employers, the formation of interdisciplinary competencies, an effective assessment and monitoring system for learning outcomes, as well as the self-development and self-improvement of teachers are just some of the key factors that will allow graduates to be prepared who meet the modern requirements of the labor market and are capable of achieving success in their professional activities.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, including financial, personal, authorship, or any other nature that could affect the research and its results presented in this article.

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Use of artificial intelligence

The authors confirm that they did not use artificial intelligence technologies when creating the presented work.

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