



INTERACTIVE TEACHING METHODS OF ELECTRICAL ENGINEERING IN THE TRAINING OF FUTURE TEACHERS OF LABOR TRAINING AND TECHNOLOGIES

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Abstract.

Relevance: due to the reform of higher education, there are the growing demands for professional training of graduates of higher education institutions and the need to move from the traditional style of teaching disciplines to innovation.

Purpose: justification and experimental verification of the effectiveness of the application of interactive teaching methods of electrical engineering in the process of professional training of future teachers of labor training and technology.

Methods: analysis of scientific literature, study of pedagogical experience, questionnaires, conversations, oral interviews to identify the effectiveness of innovative teaching methods, data systematization.

Results: there is determined the role of interactive technologies in future teachers training of labor training and technologies; it was found that the organization of education on the basis of the competence approach is relied on strengthening the practical professional orientation of education, development of pedagogical abilities and values of students; it is proved that in lectures it is necessary to give preference to interactive teaching with elements of a problem approach; laboratory classes should be conducted with the help of computer programs for modeling electronic circuits; the system of future teachers training of labor training and technologies at the first (bachelor's) level of higher education on the course "General electrical engineering and workshop on electrical work" developed on the basis of interactive training is presented; the three-component structure of criteria and corresponding indicators of the level assessment of competence formation in electrical engineering is substantiated; an experimental test of the effectiveness of the use of interactive methods of teaching electrical engineering in the training of future teachers of labor training and technologies; it is proved that the use of interactive teaching methods has a positive effect on the dynamics of the formation of competence in electrical engineering.

Conclusions: the training of a modern teacher of labor training and technologies should be carried out with the strengthening of the practical component of educational programs, and will also be effective under the condition of systematic use of interactive educational technologies.

Keywords: *electrical engineering, interactive educational technologies, interactive methods, teacher of labor training and technologies, lecture and laboratory work.*

Introduction. The objective process of modern development of the country puts forward new criteria for the quality of education: modern approaches to assessing the organization of labor and the use of energy resources require young professionals to prospects and breadth of their professional

education. In modern institutions of higher education, the arsenal of learning tools used by teachers in pedagogical activity has significantly expanded.

Sources. The introduction of innovative forms and methods of teaching was considered in the

works of V. Andrushchenko, I. Dychkivska, V. Kremen, A. Kuzminskyi, V. Luhovyi, V. Morozov, P. Saukh, T. Turkot, D. Chernilevskyi, and others.

In particular, V. Andrushchenko (2014) analyzes the relationship between the necessary innovations and the traditional component in education, which requires radical changes in the education sector. I. Dychkivska (2004) notes that innovative learning is based on the development of various forms of thinking, creative abilities, high social and adaptive capabilities of the individual. V. Luhovyi (2011) clearly agrees on the conceptual and terminological apparatus for innovative types of educational activities in the context of the competency approach.

Purpose: to substantiate and experimentally verify the effectiveness of the application of interactive teaching methods of electrical engineering in the process of professional training of future teachers of labor training and technologies.

Methods: analysis of scientific literature, study of pedagogical experience, questionnaires, conversations, oral interviews to identify the effectiveness of innovative teaching methods, data systematization.

Results and discussion. Qualitative training of students requires a creative approach of teachers to the choice of content, forms, methods and means of teaching, maximum use of the achievements of modern pedagogical science, new pedagogical and production technologies. The educator should be focused not on the transfer of ready-made knowledge, but on the formation of a set of personal qualities of the student, the organization of cooperation and self-expression in activities, creativity and understanding and recognition of another point of view.

The quality of education and training of highly qualified specialists depend on the content of education, modern teaching methods, and ways to achieve this goal. Modern requirements for the quality of professional training in higher education, changes in teaching methods, introduction of new ideas, the use of interactive technologies determines the success and adaptation of the student in modern society. For example, to implement this requirement, the lecture should be taught with elements of problem situations, in addition, significantly increased interest in non-traditional, creative tasks, and laboratory work with elements of independent, interactive, research experiment have a positive effect on students. During the general technical training of students, the main function of the teacher is to organize the acquisition of theoretical knowledge by

students and the formation of the ability to apply this knowledge in practice (Yashchuk, 2015).

Studying the experience of foreign scientists on the methods of teaching electrical engineering, we note that the educational curricula included problem lectures. As a result of the study, the authors found that students gained better knowledge in teaching problem lectures than by traditional methods. Students who participated in the survey reported that problem-based lectures provided them with self-confidence, personal abilities, and ways to solve problems, prepared them for future careers, and improved their interpersonal and community skills (Bizjak, 2008).

K. Ribeiro (2008) conducted research on student assessment after listening to a course of problem lectures on electrical engineering. As a result, it was found that this technique is more attractive and interesting for students, as it allowed to construct their own knowledge instead of the absorbed words of the teacher, which led to an independent search for information to solve problems. Students also reported that they developed specific practical skills, such as: the ability to research, express ideas, communicate and work effectively in a team.

Methods of teaching lectures on electrical engineering with elements of a problem-based approach are an effective pedagogical tool to increase students' interest in better learning. Problem presentation of the lecture changes the role of the teacher and transforms him from a traditional lecturer who takes over the whole system of knowledge on the chosen topic, to a teacher-mentor who forms and supports self-confident and self-sufficient modern professionals who make the most of opportunities and learn from different experience for self-development.

The organization of interactive learning involves modelling life situations, conducting interactive lectures, role-playing games, creating problem situations, conducting pair and group discussions, includes mandatory independent work, the use of moderation techniques, "round table", "brainstorming", case method, etc.

Issues of the basic requirements for the lecture, its varieties and methods have been the subject of research by many scientists, including A. Aleksyuk, M. Bulanova-Toporkova, S. Honcharenko, V. Holovenkin, D. Hubar, O. Zavalevska, V. Kolisnyk-Humeniuk, O. Kozakevych, A. Kuzminskyi, T. Nepomnyashcha, N. Pobirchenko, O. Pometun, O. Priadko, B. Sus, O. Furman, L. Chernyshova, V. Yahupov and others.

In the research of A. Didyk it is determined that the alternative to the usual lecture is an active model of learning – an interactive lecture that combines the leading role of the teacher with high activity of students based on the involvement of scientific interactive technologies. The essence of interactive learning is joint and mutual learning, in which the student and the teacher are equal subjects of activity. A. Didyk (2018) notes that electrical engineering and electronics contain sections, the study and understanding of which require figurative thinking, the ability to analyse and compare. Many years of experience show that students do not always have the necessary mental skills for a deep understanding of the phenomena, processes described in the sections of these disciplines. In such situations, modern interactive teaching tools come to the teacher's aid.

The interactive lecture differs from the traditional two-way flow of information, contains problematic questions from the teacher (lecturer), is distinguished by a heuristic type of learning, allows interruption of the teacher's story and discussion of topics that caused difficulties for understanding or interest students. An interactive lecture allows for impromptu speeches by a student or several students on the topic of the lecture. The purpose of an interactive lecture is to convey information and actively assimilate it by students, not to exchange views. The lecture form in the transition to the next stages of learning should be consistently replaced by discussions, reports or other forms of learning that make the process of acquiring knowledge and skills much more active and transfer some of the functions of learning management in the hands of learners.

The introduction of modern teaching methods is important, because training in high school is carried out on interactive learning technologies, so in higher.

According to I. Petrytsyn (2013), improving the quality and level of knowledge of students is possible with the use of a virtual laboratory workshop. In addition, it provides the ability to simultaneously control knowledge, which leads to improved performance.

In the research of M. Pryhodi (2018), it is noted that there is a problem of unpreparedness of a significant number of scientific and pedagogical workers to use information and computer technologies, in particular modern information and communication resources in their own educational practice.

The methodical approach of I. Petrytsyn (2013) to the teaching of laboratory work in electrical engineering with the help of computer technology deserves attention. The scientist believes that in

the study of electrical engineering it is advisable to use electronic circuit simulation programs, such as: Electronics Workbench, Multisim, Circuit Maker, etc., which have a user-friendly interface, a large library of components and are easy to use.

Let's take a closer look at computer programs for laboratory work in the preparation of students in electrical engineering.

The program-radioconstructor (emulator of electrical circuits and circles) is an electronic design tool that allows you to simulate on the monitor screen the processes of assembling electrical circuits, to explore the features of their work, to measure electrical quantities as it is done in a real physical experiment.

With the help of the design tool you can:

- to study the dependence of the resistance of conductors on the resistivity of its material, length and cross section;

- study the laws of direct current (Ohm's law for a section of a circle and Ohm's law for a complete circle);

- study the laws of series and parallel connection of conductors, capacitors and coils;

- to study the principles of application of fuses in electronic circuits;

- to study the laws of heat energy release in electric heating and lighting devices, the principles of coordination of current sources with load;

- to get acquainted with the principles of current and voltage measurements in electronic circuits with the help of modern measuring devices (multimeter, two-channel oscilloscope), to observe the type of alternating current on individual elements, phase shift between current and voltage in alternating current circuits;

- to study the influence of capacitive and inductive resistances in alternating current circuits, their dependence on the frequency of the alternating current generator and denominations of parts;

- to study the power distribution in alternating current circuits;

- to study the phenomenon of resonance in circles with series and parallel oscillatory circuit.

In the researches of A. Matviichuk, V. Harkushevskiy, V. Stinianskyi, V. Zabolotnyi, V. Sumskyi the methods of using computer programs in performing virtual laboratory works on electrical engineering and heat engineering is considered. Thus, when studying the section "Three-phase AC circuits" A. Matviichuk (2009) proposes to use the program 3DMax, as well as laboratory classes using the program EWB in the discipline "Physics". The

system of virtual laboratory works on general electrical engineering on the basis of the EWB program provides high-quality training of future teachers of labor training and technology during full-time and part-time education.

Circuit modeling programs of analog, digital and analog-digital circuits allow during the laboratory workshop to make an equivalent circuit of the device using library components, to simulate almost any electrical or electronic circuit, change the denominations of its elements with performance testing, show on the monitor real signals at any point in the circuit. It is possible to demonstrate simulated circuit errors and their impact on certain parameters of the electrical circuit.

The disadvantage of these computer programs is the inability to conduct real research of electrical circuits and radio components, which affects the ability of students to follow safety rules when working with live electrical equipment. At the same time, a conventional computer in combination with auxiliary devices can be used as a powerful research laboratory. Using computer programs of the oscilloscope, pulse generator, millivoltmeter, spectrum analyzers and microphone input of the sound card, it is possible to carry out a lot of real laboratory work, without spending considerable material resources (Matviichuk, 2009).

In order to improve the teaching methods of the discipline "General Electrical Engineering and Workshop on Electrical Works" were created virtual laboratory work on the DCACLab platform. With the help of a user-friendly interface, students have the opportunity in their free time to compose, simulate, study electrical circuits. When performing virtual laboratory work, they take readings of devices, experiment with electrical circuits, which does not lead to real emergency modes of operation and failure of devices. Performing virtual laboratory work requires from 10 minutes to 15 minutes, which requires a rational distribution of time and a certain level of theoretical training.

A questionnaire was issued to check the effectiveness of the use of interactive educational technologies and modern methods in the training of future teachers of labor training and technologies. Respondents were asked to evaluate the effectiveness of interactive methods, in particular, during the study it was necessary to solve the following tasks: to find out students' interest in virtual laboratory work, attitude to interactive lectures; determine what skills they have after taking a virtual course; to establish the level of competencies formation in electrical engineering; identify a systematic approach to

electrical training of future teachers of labor training and technologies.

The central position of the experimental study was to determine the impact of the developed methods of interactive laboratory classes and interactive lectures on the level of competence formation in electrical engineering of future teachers of labor training and technologies. An experimental group was created at the beginning of the experiment. Students from another subgroup acted as a control group.

At the ascertaining stage of the experimental research, a control section was conducted with the help of test tasks and a survey of students on the main basics of electrical engineering (material of physics and labor training of secondary education).

The effectiveness evaluation of interactive educational technologies and modern methods of electrical engineering, used by future teachers of labor training and technologies, was carried out on the basis of a three-component structure of criteria and relevant indicators of competence in electrical engineering. They are: cognitive (knowledge of electric circuit, DC and AC machines); activity (possession of basic laws and ability to solve technical problems); personal (interest in technical activities as an important component of future training, interest in increasing knowledge and skills in the field of electrical engineering).

Four levels of competence assessment in electrical engineering of teachers of labor training and technologies were used, namely:

✓ elementary – the student has partial knowledge of the basic concepts in the study of electric and magnetic circuits, linear circuits of single-phase current, the main components of machines of direct, alternating currents, knows the laws of transition from a real electric circuit to a calculated one;

✓ low – the student can distinguish a simple electrical circuit from a complex one, uses devices for measuring electrical and non-electrical quantities, has mastered the basic methods of calculating simple circuits, has some skills in building electrical circuits;

✓ middle – the student knows the basic concepts of the basic laws of electrical engineering, knows the basic parameters of electrical circuits, performs simple calculations, is able to build volt-ampere characteristics of nonlinear elements;

✓ high – has knowledge of the principle of transformers operation, DC and AC machines, low-voltage switching equipment, is able to make electrical circuits, explores the modes of operation of

electrical equipment, is able to build vector diagrams, knows the method of calculating AC and DC circuits.

The obtained test results (*Fig. 1*) made it possible to draw a number of conclusions: first, the level of competence formation in electrical engineering in the control and experimental groups are statistically

the same; secondly, students of the experimental and control groups in the vast majority have a low level of competence in electrical engineering; thirdly, the main reason for the low level of competence in electrical engineering of students is the lack of mechanisms for their involvement in electrical engineering activity in the classroom.

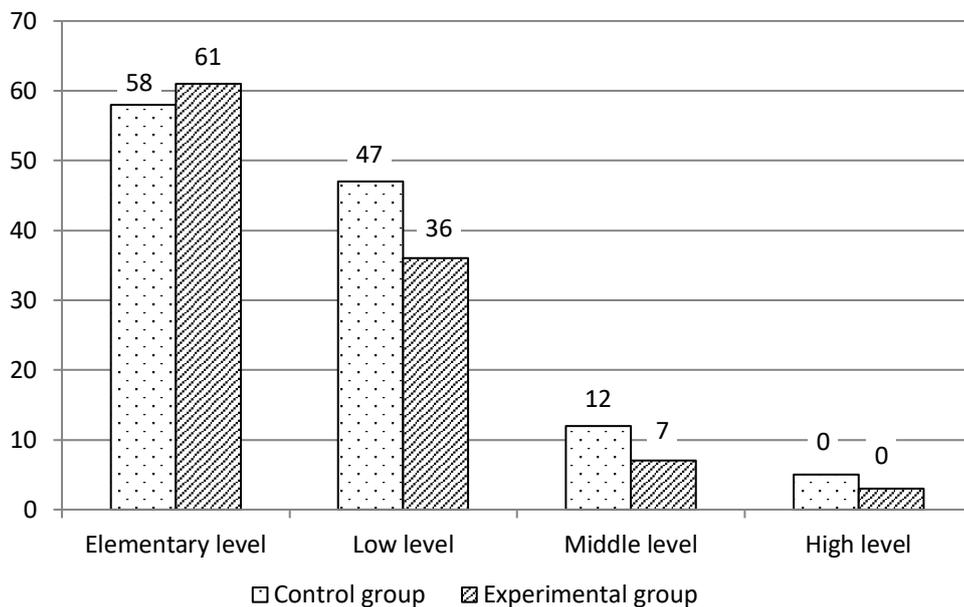


Fig. 1. Levels of competence formation in electrical engineering of future teachers (ascertaining stage)

At the formative stage, students of the experimental group were given interactive lectures and prepared for laboratory classes by independently performing work in a virtual laboratory with subsequent implementation in the workplace.

At the end of the experiment (after the final certification in the discipline "General Electrical

Engineering and Electrical Workshop"), a control test was conducted, which showed an improvement in the level of competence in electrical engineering in both control and experimental groups. However, the indicators in the experimental group are higher than in the control one (*Fig. 2*).

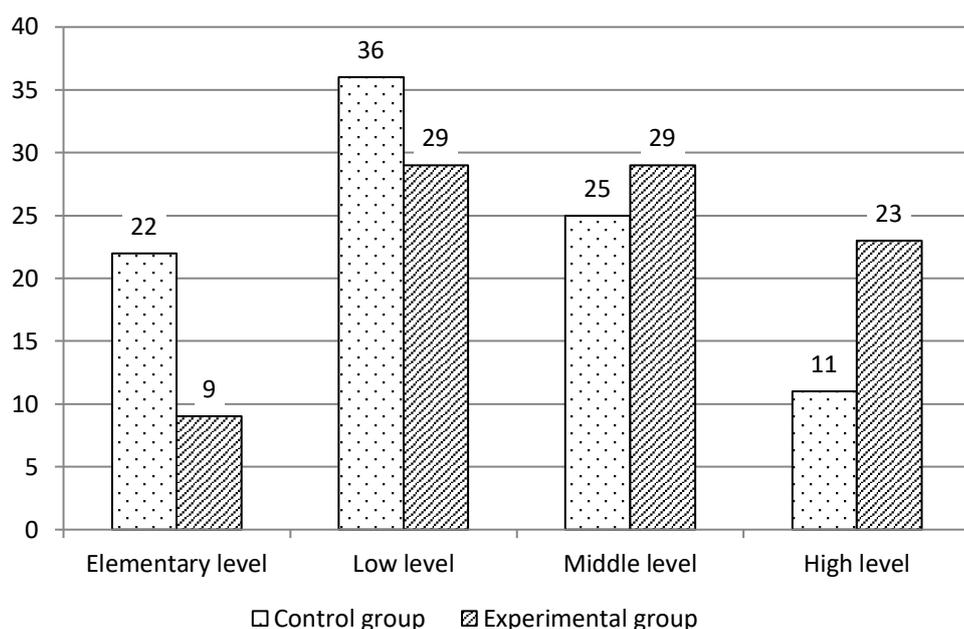


Fig. 2. Levels of competence formation in electrical engineering of future teachers (formative stage)

According to certain indicators of the competence formation in electrical engineering when using interactive teaching methods, the effectiveness of a sound method of conducting virtual lectures and laboratory classes in electrical engineering has been confirmed.

Conclusions. Interactive teaching methods contribute to the improvement of the educational process, have a positive effect on the quality of competence formation in electrical engineering. Multimedia tools modernize learning, make it visual. Conducting laboratory classes in electrical engineering will be effective only if you combine a real experiment with a virtual one. In turn, the use of virtual

laboratory work allows to increase the number of works performed within one academic hour. In addition, due to the perfect theoretical training, it is possible to combine and perform several laboratory works. Successful mastery of interactive methods and their effective use becomes the most important task of preparation of future teachers of labor training and technologies.

Prospects for further research are associated with the justification and development of a methodical system for the competence formation in electrical engineering of future teachers of labor training and technologies.

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УДК 378.011.3-051:62/69]:621.3

Застосування інтерактивних методів навчання електротехніки у процесі підготовки майбутніх учителів трудового навчання і технологій

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кандидат педагогічних наук, докторант кафедри теорії і методики технологічної освіти, креслення і комп'ютерної графіки, Національний педагогічний університет імені М.П. Драгоманова,

Реферат.

Актуальність дослідження зумовлена реформою вищої освіти, зростанням вимог до професійної підготовки випускників закладів вищої освіти, потребою переходу від традиційного стилю викладання дисциплін до інновацій.

Мета: обґрунтування та експериментальна перевірка ефективності застосування інтерактивних методів навчання електротехніки у процесі професійної підготовки майбутніх учителів трудового навчання і технологій.

Методи: аналіз наукової літератури, вивчення педагогічного досвіду, анкетування, бесіди, усне опитування з метою виявлення ефективності застосування інноваційних методів навчання, систематизація даних.

Результати: визначено роль інтерактивних технологій у підготовці майбутніх учителів трудового навчання і технологій; з'ясовано, що організація освіти на основі компетентнісного підходу базується на посиленні практичної професійної спрямованості навчання, розвитку педагогічних здібностей і ціннісних орієнтирів студентів; доведено, що на лекційних заняттях перевагу варто надавати інтерактивному навчанню з елементами проблемного підходу; лабораторні заняття доцільно проводити за допомогою комп'ютерних програм з моделювання електронних схем; презентовано розроблену на засадах інтерактивного навчання систему підготовки майбутніх учителів трудового навчання і технологій на першому (бакалаврському) рівні вищої освіти з курсу «Загальна електротехніка та практикум з електромонтажних робіт»; обґрунтовано трикомпонентну структуру критеріїв та відповідних показників оцінювання рівня сформованості компетентності з електротехніки; здійснено експериментальну перевірку ефективності застосування інтерактивних методів навчання електротехніки

при підготовці майбутніх учителів трудового навчання і технологій; доведено, що використання інтерактивних методів навчання позитивно впливає на динаміку сформованості компетентності з електротехніки.

Висновки: підготовка сучасного вчителя трудового навчання і технологій повинна здійснюватися з посиленням практичної складової освітніх програм, а також матиме ефективність за умови системного використання інтерактивних освітніх технологій.

Ключові слова: *електротехніка, інтерактивні освітні технології, інтерактивні методи, вчитель трудового навчання і технологій, лекція і лабораторна робота.*

Received: 02 August 2020

Accept: 25 September 2020