POSSIBILITIES OF APPLICATION OF MODERN DIGITAL INNOVATIVE MULTISIM PROGRAM TECHNOLOGIES IN TEACHING ELECTRICAL ENGINEERING

Ikromjon Tursunov
Doctor of Physical and Mathematical Sciences
Chirchik State Pedagogical Institute, Uzbekistan,

Umid Eshniyozov
Chirchik State Pedagogical Institute, Uzbekistan, Teacher

ABSTRACT

The article describes how to organize the teaching of electrical engineering using modern digital innovative interactive Multisim program. Information on students' interest in research work is provided.

Keywords: modern information technology, pedagogy, innovative technology, Multisim program.

INTRODUCTION

According to the Decree of the President of the Republic of Uzbekistan [1], the following tasks should be performed on the introduction of digital technologies and modern methods in the educational process:

• Ensuring strong integration of modern information and communication technologies and educational technologies, individualization of educational processes on the basis of digital technologies, widespread introduction of distance learning technologies in practice;

• Organization of distance learning programs based on modern information and communication technologies;

• Develop the use of modern software products that are widely used internationally in the educational process, based on the specifics of the field of study and specialization.

According to the decree, one of the main tasks is to ensure a strong integration of modern information and communication technologies and educational technologies, individualization of educational processes on the basis of digital technologies, development of distance learning services, widespread introduction of modern technologies.

The use of modern technologies in educational practice is an integral part of the modernization of the education system. In modern conditions, the technologicalization of educational processes allows to achieve the expected result with less effort and time, improve the quality and increase the effectiveness of teaching [4]. The use of information and communication technologies is also a pedagogical process, which includes changes in student and teacher activities, innovation, the full use of interactive methods in the learning process. The use of interactive electronic Multisim software in the teaching of electrical engineering in higher education brings a new level of quality to the educational process. This not only makes it easier for the teacher to prepare and conduct the lesson, but also creates new opportunities [4-5].

METHODS

In order to achieve a guaranteed result in the teaching of electrical engineering, it is necessary to have a technical, electronic software, didactic and preparatory environment in the organization of the information-educational system of teaching. They are the following :

Technical environment: a computer room, computers connected to the Internet and interactive software "Multisim".

Didactic environment: Multisim-controlled, fully utilized programs should have teaching aids, teaching and supervising e-learning materials, and guidelines. To create such an environment, you need to pay attention to the following:

Technical problems: personal computer, devices for their operation and "Multisim" program;

Didactic problems: teaching aids for use in the education system, teaching and control e-learning materials;

Preparatory problems: The electrical engineering teacher must have a high level of knowledge of the computer, its accessories, interactive training programs and the Internet. To do this, it is necessary to expand the use of information and communication technologies and modern interactive "Multisim" in the teaching of electrical engineering.

Basic rules and requirements for using multisim software [3-4].

Table 1.*Basic keys used in Multisim (*table 1*).*

| Ctrl+H	Create a new file	Ctrl +J	Insert a partition
Ctrl +O	Open the file	Ctrl +Q	Add a cable
Ctrl +C	Save the daily file	Ctrl +I	Insert the connector
Ctrl +P	Write graphs / log file	Ctrl +B	Insert a thumbnail
Ctrl +Z	Lose gestures	Ctrl +T	Insert text
Ctrl +X	Cut	F5	Run the scheme
Ctrl +C	Copy	F6	Pause
Ctrl +V	Position	Alt+Y	Vertically display in a window
Ctrl +D	Circuit Description Opens Box	Alt+X	Horizontal mirroring
Ctrl +F	Search	Ctrl +R	Rotate 90 degrees to the right
Delete	A Loss of selected group	Ctrl +Shift+R	90 degree left turn
Ctrl +W	Device selection	Cursor keys	Moves selected devices left, right, up, down

Multisim environment (Figure 1.)
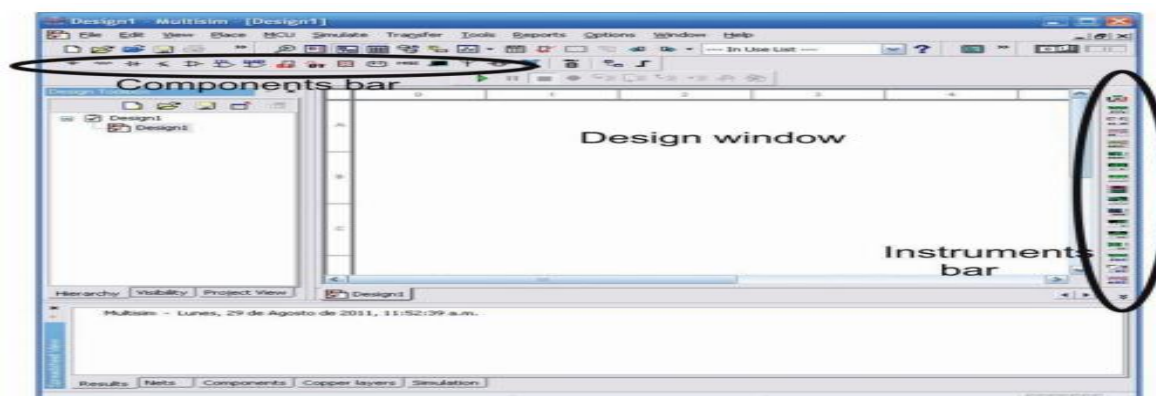
Figure1.

When you click on the "Multisim" icon, the main window of the program will be displayed. At the top of it is a command menu window. When you click the File button in the menu, the folders of files in the program will appear. The work can be started from typical radio-electronic circuits. For example, files. The MCU is in the form of a schematic representation of various devices.

The schematics work window forms the central part of the application window. In this window, various electrical circuits are created and edited using radio elements and connecting wires. It is possible to connect different measuring instruments to the circuits. To do this, select the desired measuring tool from the Instruments icon on the right side of the menu window. The icons allow you to choose from a variety of active and passive radio elements, measuring instruments and indicators.

To select an item, double-click the icon to display the icon line. Then select the item and click "OK", the item will drop into the experiment window. When you hover the mouse pointer over this item, the item will turn red or be highlighted with a barcode. Now the parameters and sizes of this item are selected after double-clicking the button and the item menu is displayed. This menu selects the type, unit of measure, and other parameters for each item.

The window's item bar contains the Run / Stop icon and the Pause icon. It should be noted that it is not necessary to keep the circuit in the activated state for a long time, as repeated checks of the data over a long period of time can lead to accumulation of large errors in the calculations, which can cause the modeling program to crash. will bring.

One of the unique features of the multimedia program is the intensive use of a computer mouse. The keyboard is used for typing, entering numbers, and quickly calling commands. Working with a multisim program is divided into 3 main stages:

1. Create a scheme;
2. Selection and installation of measuring instruments;
3. Activation of the scheme, i. e the calculation and control of the currents in the device under study.

To create a schema, most actions are performed with the left mouse button. The right mouse button is used to call up the context menu, that is, to change the properties of elements or measuring instruments.

When creating an optional chain, the following steps are performed:

❖ Search and find the necessary radio elements;
❖ These elements are installed in the workspace of the program window;
❖ Elements are connected with wires according to the scheme;
❖ The parameters and values of the elements are set.

The search and selection of radio elements is performed with the mouse and the second character ruler. When you hover the mouse pointer over an item, the context of what the item is appears in the context menu, which means that the error in selecting the item is eliminated. Often mistakes are made in the selection of power sources (for example, the current source is replaced by a voltage source). It is necessary to include a Ground element in the scheme, otherwise the correct calculation of the scheme is not guaranteed.

Component Review

Multimedia has three levels of databases (Figure2):

❖ Only information from the Master Database can be calculated, which contains all the components;

❖ Compatible with the user's daily database (User Database). It is intended to store components, and these components cannot be displayed in the public domain;

❖ The Corporate Database is designed for components that are accessible to other users in the network.

Database management tools allow you to move components, combine two databases into one, and analyze them[3-4].
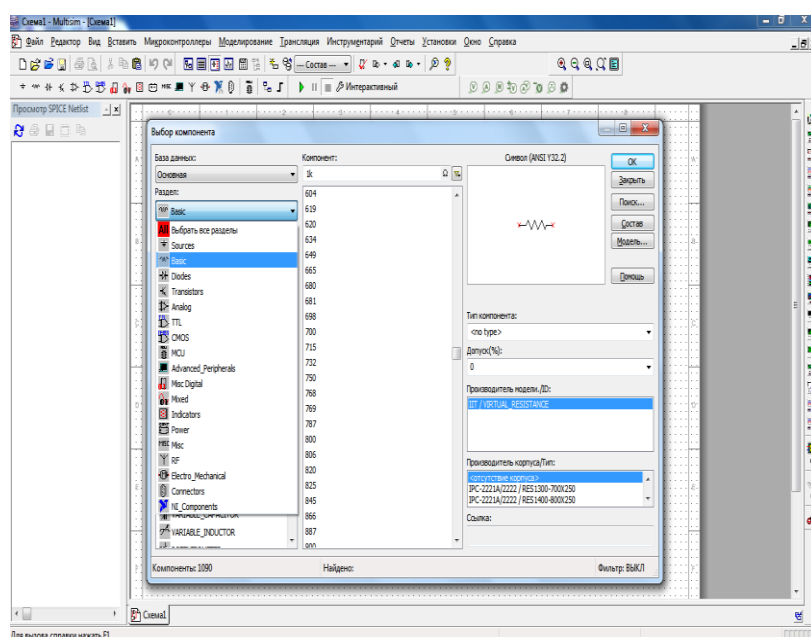

Figure2.

All databases are divided into groups, which in turn are divided into families. When a user selects a component and places it in a schema, a new copy is created. All changes to it do not affect the information stored in the database.

The Master Database is divided into twelve groups:

1. Sources. It consists of all voltage and current sources and ground connections. For example, POWER SOURCES (fixed, alternating voltage sources grounded, wireless connections - VCC, VDD, VSS, VEE), signal voltage Sources (rectangular pulse sources signal through a certain time interval sources).

2. Basic. It consists of the basic elements of the circuit: resistors, inductive elements, capacitive elements, switches, transformers, relays, connectors and more.

3. Diodes. There are many types of diodes: photodiodes, shot diodes, light emitting diodes and more.

4. Transistors. It consists of different types of transistors: pnp, npn transistors, bipolar transistors and others.

5. Analog. It consists of all types of amplifiers: practical, differential, inverter and others.

6. TTL. Transistor - A transistor consists of logic elements.

7. CMOS. - consists of logical elements.

8. MCU is a multi-point communication controller.

9. Advanced_Peripherals. It consists of external devices that can be connected. (display, terminal, keyboard area).

10. Misc Digital. It consists of various digital devices.

11. Mixed. It consists of combined components.

12. Indicators. From measuring instruments (voltmeters, ammeters), lamps, etc.

Multimeter

The multimeter is designed to measure alternating current or voltage, resistance or attenuation between two parts of a circuit. The measuring range of the multimeter is selected automatically. Its internal resistance and current are close to the ideal value but can be changed (Figure3).
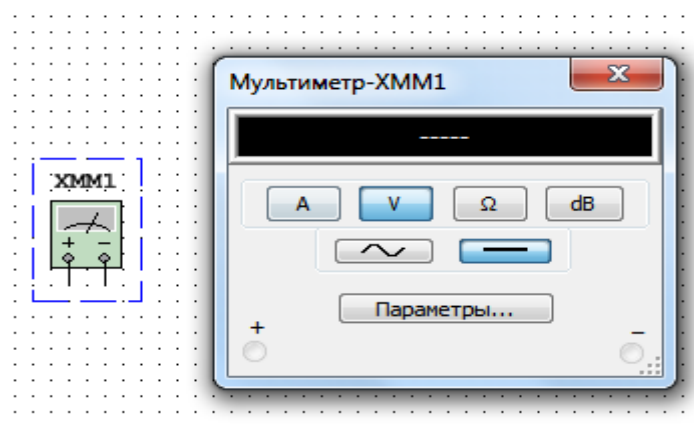

Figure3.

Signal Generator

A signal generator (functional generator) is a voltage source that can generate right-angled, arc, and sinusoidal pulses. You can change the frequency, amplitude, fill factor, and shift constant of the signal shape. The generator can generate a range of values from a few hertz to audio and radio frequencies (Figure4).
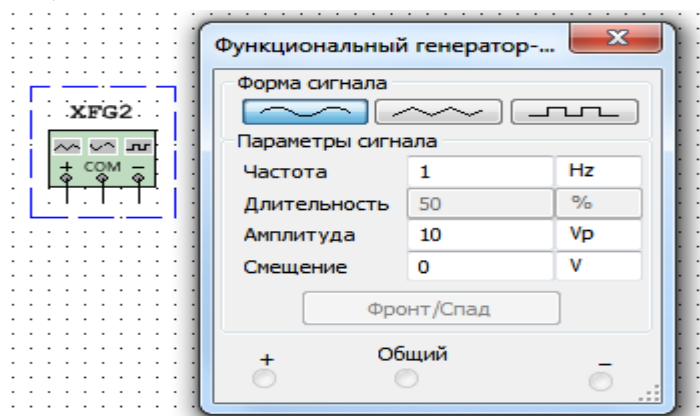

Figure4.

Oscilloscope

The multisim has several modifications of the oscilloscope. We can manage them as real. They allow you to select the type of voltage and propagation time settings and run the measurement level (Figure5).

Multisim has the following oscilloscopes:

- 2-x channels
- 4-x channels
- Mixed signal oscillography - Agilent 54622D
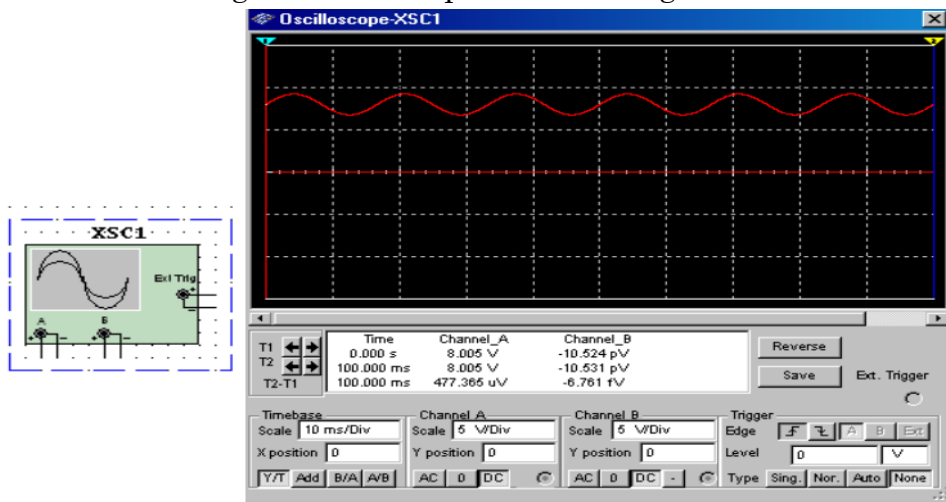- 4-x channel digital oscilloscope for recording TectronixTDS 2024

Figure5.

Frequency Character Builder (Plotter Bode)

Reviewing input and output signals reflects the phase or amplitude response. This is very handy when analyzing the controls of pallet filters (Figure6).
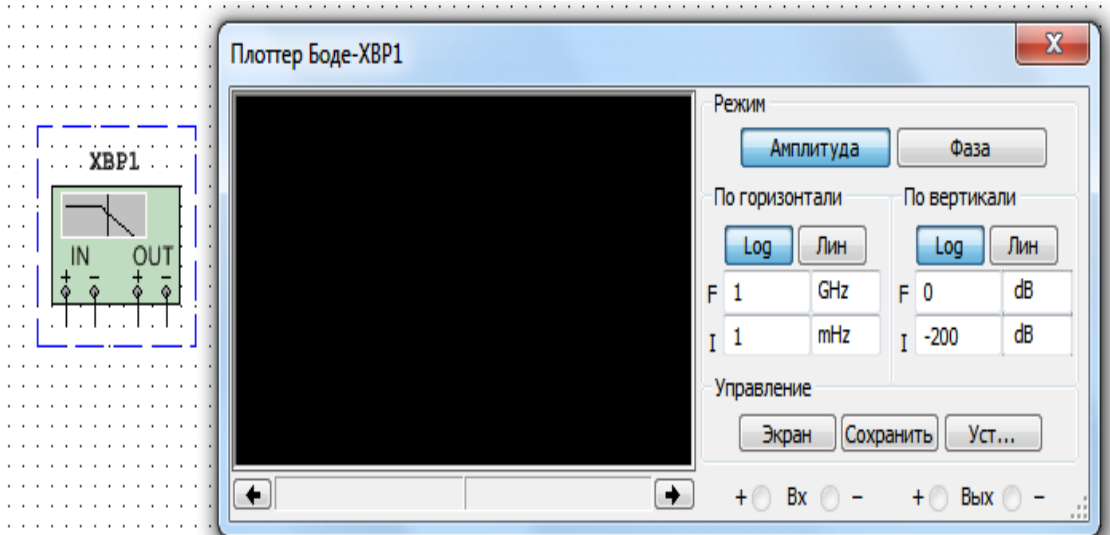

Figure6.

Spectral Analyzer

The Spectral Analyzer (Spectrum Analyzer) helps to measure the amplitude of harmonics at a given frequency. It can also measure signal strength and frequency components, and detect the presence of harmonics in a signal (Figure7). The results of the operation of the spectral analyzer

are reflected in the frequency domain, not in the time domain. Typically, this time function of the signal uses an oscilloscope to measure it. In some cases, a sinusoidal signal is expected, but it may contain additional harmonics, making it impossible to measure the signal level. If the signal is measured in a spectral analyzer, the frequency composition of the signal is obtained, i. e the amplitude of the main and auxiliary harmonics is determined [3].
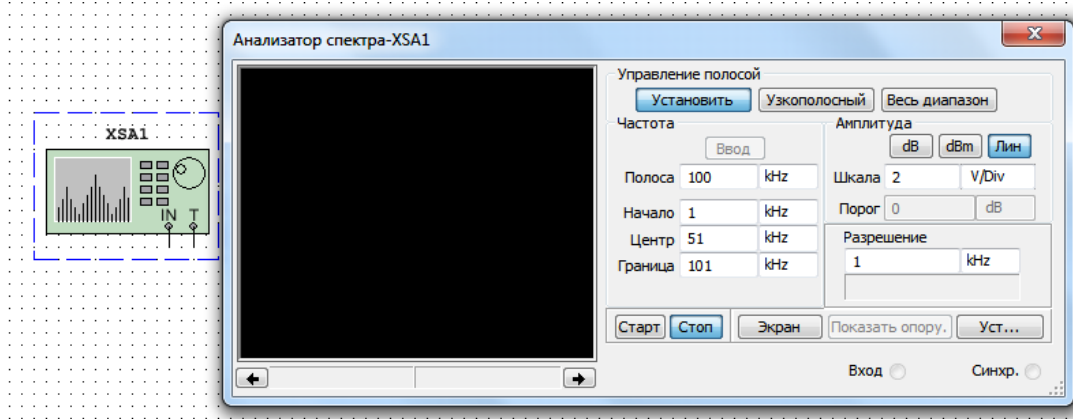

Figure7.

Wattmeter

A wattmeter is a device used to measure power and power factor (Figure8).
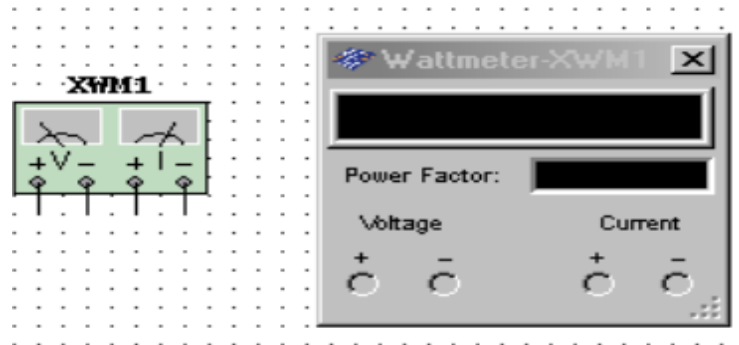

Figure8.

Measuring tester

Indicates constant and variable voltages and currents in the circuit section as well as the signal frequency (Figure9).
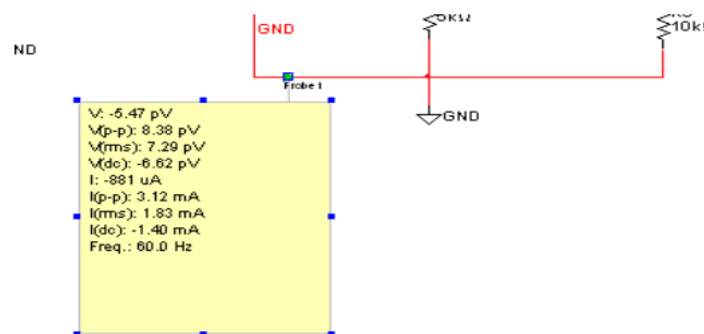

Figure9.

Topology of Schemes

The circuit must not have an inductance circuit consisting of a voltage source and coils.

1. Power supplies should not be connected in series.

2. There should be no short-circuited coils.

3. The voltage source must be connected to the transformer and the inductor via a series-connected resistor. The resistor must be connected in parallel to the capacitor connected to the current source.

The modern teacher of electrical engineering has the opportunity to increase the student's interest in electrical engineering, to achieve lesson effectiveness, to further develop students' thinking, comprehension, free and independent thinking, to see invisible processes, to model electrical processes. The goal is to do.

When a teacher teaches electronics using the Multisim program, one of the information and communication tools to solve these problems, he or she will have the following opportunities compared to traditional teaching.

1. It is a universal and necessary tool in the field of data collection, processing, automatic control, energy conversion in electronics and electrical engineering.

2. With the help of Multisim software installed with information and communication technologies, the creation of chains can be done in a few seconds.

3. Multisim allows you to combine the development and testing of electronic devices based on the technology of virtual devices for educational purposes.

4. Possibility of independent construction of various electrical circuits (circuits).

5. The very wide range of electronic material and technical base.

6. Possibility of attractive assembly of electrical circuits.

7. Accuracy of electrical laboratory equipment and measurement results.

8. Ability to compare and analyze the obtained graphs.

9. Ability to get acquainted with the designation, properties and brands of electrotechnical elements in the scheme.

10. Visual observation of electrotechnical laws (processes).

11. Students have the opportunity to test their ideas and innovations.

12. When working with a multisim program, the student feels free, is not afraid to make mistakes, because there is an opportunity to correct mistakes quickly and effectively.

It is possible to assemble any electrical circuit (circuit) in electrical training, in the training conducted through the Multisim program.

Students work individually, in groups, and in groups. Working in a multisim program gives students aesthetic pleasure and increases their interest in science. The use of game techniques allows students to master difficult topics on their own. It works best when used in multisim lectures as well. Integral use of these programs will help even low-achieving students to master the subject. As a result, it is possible for all students to achieve the effectiveness of the course in electrical engineering.

The fact that some students do not master the subject is not because they do not know it well, but because they have symptoms of shyness and fear. The Multisim program helps students overcome such traits. The program can be widely used to ask students for lessons learned, to assemble electrical circuits, to observe the processes in a circuit, to obtain various searchable

values, to draw graphs, and to analyze the results obtained. It should be noted that in the process of conducting experiments, if there is a lack of equipment in the electrical laboratory and practical training, if the equipment is defective, it is possible to conduct the experiment through a virtual laboratory.

The uniqueness of such methods is that they are carried out only through the interaction of students and teachers. This process of cooperation has its own characteristics. That is:

❖ Ensure the constant interest of students in science in the educational process;

❖ To allow students to think, create and research independently during the lesson;

❖ Strengthen students' interest in science and their desire to acquire knowledge through a creative approach to each issue independently.

RESULTS AND DISCUSSION

In order to determine the results of the study of electrical engineering on the basis of the Multisim program, pedagogical experiments were carried out.

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In the 2019-2020 academic year, pedagogical experiments were carried out in groups Chirchik State Pedagogical Institute of Tashkent region. 44 students from group were selected as a control group, and 46 students from were selected as an experimental group.

The following results were obtained when using the Multisim program in the teaching of electrical engineering.

Criteria for assessing the level of development of students' knowledge of electrical engineering **(Table 2)**

Table 2

Evaluation criteria	
Evaluation indicators	**5 "excellent"** - the ability to solve problems based on theoretical knowledge in the field of electrical engineering, perform laboratory work and draw conclusions based on the results obtained. If he can think creatively, if he can think independently, apply his knowledge in practice, if he understands its essence, if he can tell, if he has a broad vision.
	4 "good" - Must be able to apply the concepts in the study of the basics of science and processes, be able to observe independently, apply their knowledge in practice, understand the essence, know, tell, have imagination.
	3 "satisfactory" - Must be able to use and apply the elements of science in the study of the basics of science and processes. If he understands their essence, if he knows, if he tells, if he has imagination.
	2 "unsatisfactory" - There are serious flaws in the definitions given to the concepts, no examples of these concepts are given or the examples are chosen incorrectly (no idea about the concept). An attempt was made to resolve the issue. Rough mistakes were made. If you do not have a clear idea.

In order to express more accurately the difference between the quality level noted by the participants attached to the experimental and control groups according to their performance, we have found the coefficient values.

Table2. The average coefficient of the level of development of knowledge in electrical engineering by the participants (students)

Table 3.

experimental group	Q_{11}	Q_{12}	Q_{13}	control group	Q_{21}	Q_{22}	Q_{23}	Average value T
n1	Excellent (5)	good(4)	satisfactory(3)	n2	Excellent (5)	good(4)	satisfactory(3)	
46	2	13	31	44	1	7	36	T_{ex}=4.06
46	5	17	24	44	3	9	32	T_{co}=2,46

$$T = \frac{1}{n_1 n_2}\{\frac{(n_1 O_{21} - n_2 O_{11})^2}{O_{11} + O_{21}} + \frac{(n_1 O_{22} - n_2 O_{12})^2}{O_{12} + O_{22}} + \frac{(n_1 O_{23} - n_2 O_{13})^2}{O_{13} + O_{23}}\}$$

The resulting value does not fall within the reliability range.

The dynamic changes in the control and experimental groups are shown in the histograms 1.
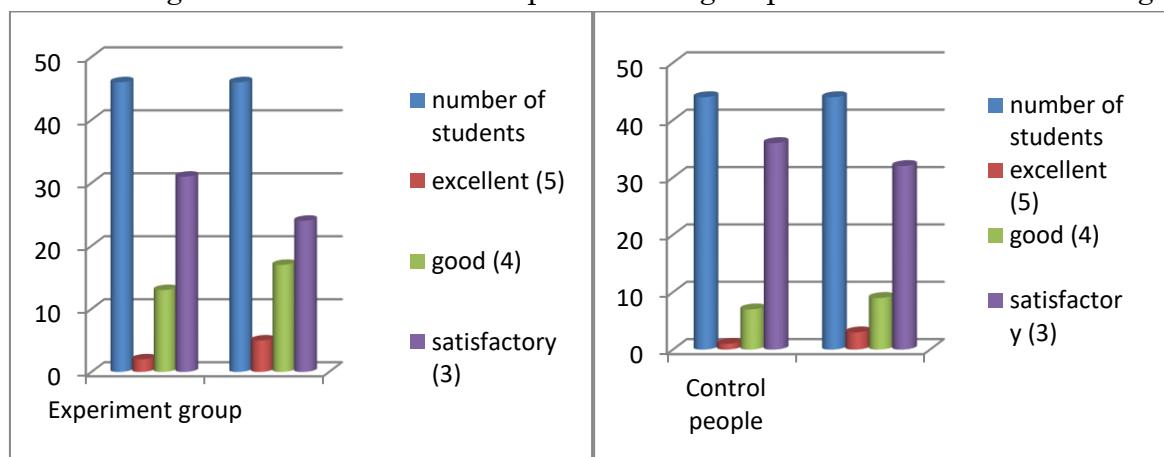

Figure10. Histograms of dynamic changes in control and experimental groups.

Thus, the results of the experimental work of the research lead to the validity of the final conclusion, which indicates that the level of development of students' knowledge in electrical engineering classes has increased. The obtained results confirmed the effectiveness of the experimental work.

Based on the above pedagogical experience test results, we came to the following conclusions.

CONCLUSION

❖ Multisim software allows you to create, model, and learn simple or complex analog and digital devices.

❖ Creating electrical circuits allows you to get the exact results you are looking for in a short time and make the graphs look attractive. Students develop independent thinking in electrotechnics based on the Multisim program.

❖ Theoretical knowledge gained during the lectures will be strengthened. Students will be able to analyze the results of practical work. This will increase students 'interest in science and research.

❖ Due to the high demand for distance learning today, the Multisim program can be used effectively in all classes of electrical engineering. It constantly develops students' interest in research and teaches them how to use their time efficiently.

❖ With the Multisim program, it will be possible to develop the independent learning activities of future professionals, to ensure the coexistence of teaching and research, to involve students in research, and on this basis to train and improve the quality of mature professionals.

REFERENCES

1. Decree of the President of the Republic of Uzbekistan dated August 8, 2019 No PF-5847 "On approval of the Concept of development of the higher education system of the Republic of Uzbekistan until 2030".
2. Muslimov.N.A., And others Educational-methodical complex on the module // "Innovative educational technologies and pedagogical competence". T.TDPU 2016.
3. Corbin M.J., Multisim: An object-based distributed framework for mission simulation Simulation Practice and Theory - 15 January 1996, Vol. 3. - Issue 6. - P. 383-399.
4. Herniter M.E., Electronic modeling in Multisim // - M: DMK Press, 2010. 501 p.
5. U.A.Eshniyozov. To develop students' professional competencies in the field of electrical engineering // Academic Research in Educational Sciences Volume 2, Issue 12, 2021. pp.362-370
6. I.G. Tursunov, U.A.Eshniyozov, Sh.A.Durdiyeva. Turli-muhitlarda-elektr-toki-mavzusini-oqitishdagi-innovatsiyalar // Academic Research in Educational Sciences (ARES), volume.2, issue.2, pp, 513-523 b.
7. I.G. Tursunov, U.A.Eshniyozov.Elektrotexnika fanini o'qitishda innovatsion texnologiyalarni qo'llash // Academic Research in Educational Sciences (ARES), volume.2, issue.4, pp.1030-1040
8. Elektrotexnika fanini o'qitish jarayonida talabalarning kasbiy kompetentlik ko'nikmalarini rivojlantirish // Academic Research in Educational Sciences (ARES), volume.2, issue.12, pp.362-370
9. Umbarov, A., & Ernazarov, A. (2022). Possibilities of using innovative educational technologies in organizing practical training in the optical department. Science and innovation, 1(B8), 202-205.
10. Ernazarov A. F., Actors for the development of independent study skills of electromagnetism students of general education schools // Science and innovation. – 2022. – Т. 1. – №. B7. – C. 588-591.