призводити до резонансу в мережі на високій частоті, і отже, до збільшення окремих гармонік струму і напруги.

Висновок. Аналіз показав, що вищі гармоніки завдають шкоди електричним мережам, призводять до перевантажень, знижують термін служби та за певних умов можуть викликати передчасний вихід з ладу електричних та електронних споживачів. У зв'язку з цим виникає необхідність у розробці методів для виявлення вищі гармоніки та зменшення їх шкідливих впливів. Тому необхідно розробити методику оцінки впливу основного обладнання електричних мереж на спотворення форми кривої напруги, яка дозволить визначити джерела та ступінь впливу на систему електропостачання.

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TECHNOLOGY OF USING VIRTUAL PRACTICAL WORKS IN THE TRAINING OF ELECTRICAL ENGINEERING SPECIALISTS

Churylo R. E. - *master of industrial training departments of electric power engineering, electrical engineering and electromechanics*
Mykolaiv National Agrarian University, Ukraine

The analysis and development of technology and model for the use of virtual practical works in the training of specialists in electrical engineering. As a result, it is determined that the training of specialists in electrical engineering in modern the world is moving to a fundamentally new level
Key words: *virtual reality, augmented reality, educational process, specialists in electrical engineering, virtual practical work.*

Goal: development of technology and models for the use of virtual practical work in the training of specialists in electrical engineering.

Introduction. Personal development of a specialist in electrical engineering occurs during the period of study at a higher educational institution. The current generation of higher education, in particular in the field of electrical engineering, global competition in higher education, the development of e-learning - all this leads to a paradigm shift in education, to a new understanding of how a modern electrical engineer can and

should learn. Engineering education faces challenges that are gaining importance. Mobile applications, online classes and virtual reality have become part of everyday life and radically change the process of training. The digitalization of education and the means for the perception of virtual information, virtual computer environments and augmented reality require the improvement of the technology of training specialists in electrical engineering by means of virtual practical work.

Presentation of the main research material. The training of specialists in electrical engineering in the modern world is moving to a fundamentally new level. Content for training becomes obsolete by the time of graduation, as modern technology changes every year. Accordingly, such technologies are needed that will make it possible to qualitatively train specialists in electrical engineering, taking into account the peculiarities of technological progress and the renewal of the educational system. Therefore, each cycle of training of specialists in electrical engineering should be focused on taking into account educational needs in the context of technological progress [1].

Training of specialists in electrical engineering today can be considered both professional and educational-scientific. If the first type of training is aimed at professional activities and the acquisition of competencies in the relevant specialty, the second type of training is focused on improving the scientific aspects of the activities of future professionals. The educational and scientific training of masters is the object of our research. Consider in more detail such definitions as "education", "educational technology for the use of virtual practical work" and "training of specialists in electrical engineering".

The use of virtual practical work is an important practical component of the educational process in a pandemic and modern digitalization. The practical component is one of the important parts of professional training programs for applicants for higher education in these specialties. As a rule, it is realized with the help of laboratory, practical (seminar) classes, etc. The Order of the Ministry of Education and Science of Ukraine №40 of January 21, 2004 stipulates that the laboratory may be conducted in person in specially equipped training laboratories; remotely using appropriate simulation programs (emulators), simulators, virtual laboratories, etc., ie -

virtual practical learning tools or a mixed scheme. Such virtual practical teaching aids can be: electronic (virtual) simulator, electronic laboratory workshop, virtual laboratory workshop, automated laboratory workshop, automated laboratory workshop with remote access [2].

Virtual practical work is a form of training in which the applicant under the guidance of a teacher personally conducts field or simulation experiments or experiments to confirm certain theoretical provisions of the discipline, acquires practical skills in working with virtual laboratory equipment in a particular subject area.

Also, virtual laboratory work is considered as an information system that interactively models a real technical object and its essential for the study of properties with the use of computer visualization.

Under the educational technology of virtual practical work we understand a complex consisting of the presentation of planned learning outcomes, tools for diagnosing the current state of applicants, a set of virtual models and criteria for their selection for specific conditions, which involves field or simulation experiments or experiments to confirm individual theoretical provisions of the discipline, acquires practical skills [3].

Consider the model of using virtual practical work in the training of specialists in electrical engineering (Fig. 1.1).

In today's world there is a need to visualize modern models of electrical elements in 3D-dimensional space. Digitization and the needs of remote practical work of specialists in the electrical industry outline the purpose of the model - the development of technology for the use of virtual practical work in the training of specialists in electrical engineering [4].

For an illustrative example, I would like to present a virtual model of one of the practical works (Fig. 1.2.)

Conclusion. Thus, analyzing a number of literature sources, it can be noted that the training of specialists in electrical engineering in the modern world is moving to a fundamentally new level**.**

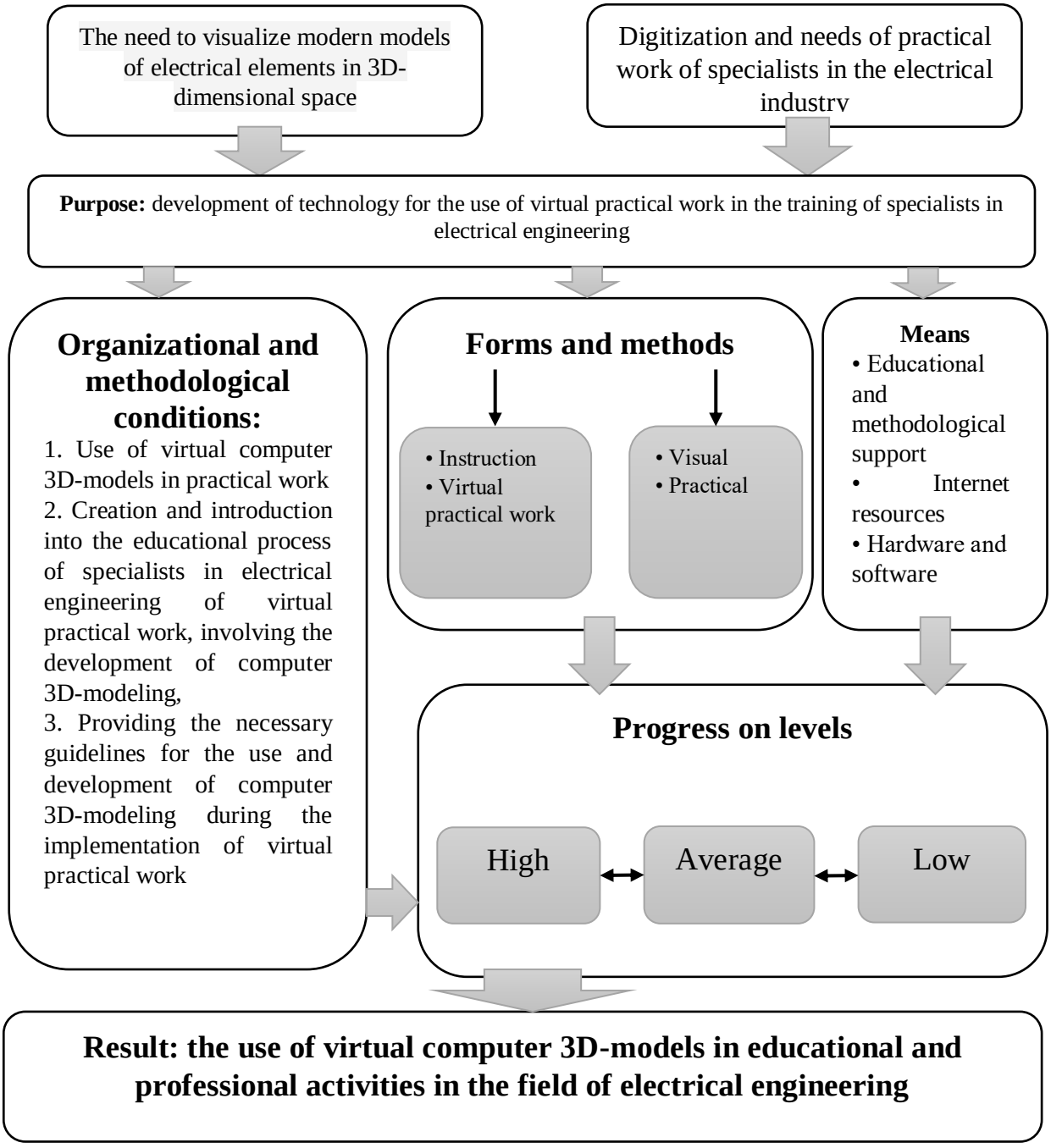

Fig. 1 .1. Model of use of virtual practical works at preparation of experts in electrical engineering

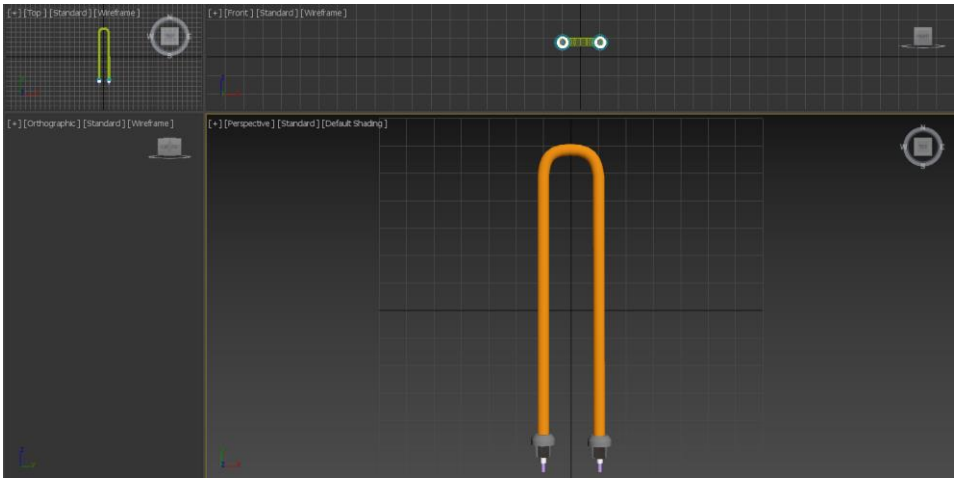

Fig. 1. 2. Practical work №2 "Tubular electric heaters"

Thus, the educational technology of virtual practical work will be understood as a complex consisting of the presentation of planned learning outcomes, tools for diagnosing the current state of applicants, a set of virtual models and criteria for their selection for specific conditions, which involves field or simulation experiments or experiments to confirm individual theoretical provisions of the discipline, acquires practical skills. Based on the analysis of the features of the engineering profession in the field of electrical engineering, the educational technology of using virtual practical work in the training of electrical engineers will mean a set consisting of presenting the planned results of training of electrical engineers, a set of virtual models and criteria for their selection in context study of electric power disciplines, which involves field or simulation experiments or experiments to confirm certain theoretical positions in the field of electric power, acquires practical skills in the specialty.

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