

Improving the Training of Skilled Workers for Professional Activities in Educational Institutions of Ukraine

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Abstract: The article talks about the author's improvement of the training of skilled workers for professional activity and its effectiveness. The purpose of the research is a theoretical study of the problems of organizing the training of skilled workers and experimental verification, proposed by the authors of the organization within the framework of the experiment. The research methods are theoretical (analysis, synthesis, modeling, comparison, systematization, generalization) and empirical (a wide range of diagnostic techniques), as well as methods of mathematical statistics with testing the null hypothesis by the chi-squared test. New information and digital technologies based on the use of personal computers and multimedia tools were widely used during the training. Extracurricular work in general, general technical and special disciplines, which was carried out according to our methodology was systematic, its content was focused on the professions that are mastered by students of vocational education schools (VES). Percentages that reflect the number of correct answers at higher levels (III-IV) in the experimental groups exceed similar indicators for control groups with a reliability of 95-99.9%. Thus, the examination of the pedagogical capabilities of the proposed organization of training in VES confirmed that it provides high results of training of skilled workers in vocational education institutions. International significance of the article. The article proposes the author's effective (experimentally verified) organization of training for transitional education systems in developing countries. This system can become the basis for the development of national systems for organizing vocational education in post-totalitarian countries.

Keywords: *Organization of training, system, didactic support, qualification characteristics, information technologies, extracurricular work.*

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Introduction

In the Western European context, the new socio-economic conditions for the development of Ukraine and the dynamic changes in technics and technology in accordance with the achievements of the scientific, technical and information technology revolution make it necessary to study the theoretical and methodological foundations of training qualified workers for various industries, agricultural production and the field of public services population.

Acceleration of scientific and technological progress, the intensive nature of the development of modern technological processes and increasing requirements for the production functions of the employee (worker, technician, engineer) necessitate the improvement of training. Modern production increasingly needs workers who have a wide technical worldview, able to respond quickly to any changes in the technological process, able to predict the consequences of these changes, plan their actions independently determine the most rational methods of work. All this requires from the employee a thorough knowledge of the relevant profession (Gerasymova et al., 2019; Nerubasska & Maksymchuk, 2020; Nerubasska et al., 2020).

In the XXI century, vocational education has become one of the most important social institutions of society. Professional competence is now a crucial prerequisite for the production of high quality goods and the provision of modern services to the population. A high level of vocational education is an important factor in stimulating economic development and ensuring the competitiveness of the economy internationally.

The effectiveness of vocational education is not only measured by economic parameters. It is the most important factor of personal development, ensuring an active life position of each person, a means of his individual self-realization. In this regard, the new policy in the field of vocational education should be aimed at achieving the following interrelated goals: to promote personal development, socio-political progress of the state, providing the country with the necessary level of qualifications.

The modern system of vocational education of Ukraine is focused on meeting the needs of various sectors of the economy in the workforce at the level of modern and future requirements, to become one of the important means of implementing state employment policy and social protection. In the transition to market relations, the main tasks of vocational education are the training of skilled, competitive workers with a high level of

professional knowledge, skills and abilities. This is required by modern scientific and technological progress, market relations in the economy, the need to educate socially active members of society, the formation of their scientific worldview, creative thinking, high spiritual qualities, national consciousness.

General remarks have been made long ago on the improvement of the vocational education system by Ukrainian scientists. For example, solving the problems of this educational field, a new pedagogical paradigm of vocational education is impossible without raising the pedagogical intellectual culture, without the obligatory overcoming of established stereotypes, conservatism in pedagogical science and practice (Batyshev, 1988). And this is directly related to the development of new content and technology of learning material and the formation of future skilled workers' ability to independently acquire knowledge and transform them into skills and abilities of creative work.

The successful solution of educational problems in such conditions depends on the level of development of vocational education, its content and innovative learning technologies (Makhmutov, 1985). There is no doubt that the practical implementation of modern trends in the development of vocational education is directly related to the issues, content and technology of education, i.e., the very essence of the educational process.

Restructuring involves the implementation of complex tasks in the field of education, requires the development and implementation of a new concept of vocational education, its standards, curricula, programs, textbooks, manuals. This applies to educational institutions of various types and levels of accreditation, including technical lyceums, higher vocational schools, colleges, etc.

To prevent the learning process in vocational and technical institutions from acquiring a subjective-intuitive or imperative character, this requires complex intersectoral psychological, pedagogical and methodological research. It should be aimed at defining new foundations of education, training and conceptual ways of introducing it into the educational process of vocational education institutions, developing new pedagogical technologies that should take into account the main socio-cultural trends in the development of modern society, in particular, such as increasing humanitarian potential of a person in his communication with the environment, the growth of manufacturability of production based on new

information technologies, the fundamentalization of education, the global nature of ecological thinking, etc.

Considerable attention requires the solution of the problem of organizing training in VES, that is, the search for internal orderliness, consistency in the interaction of parts of an integral educational process (Makhmutov, 1985). The same applies to intersubject and external relations.

The relevance of research. The above considerations, as well as the analysis of the Ukrainian psychological, pedagogical and methodological literature on the problem of research and mass pedagogical practice of the work of ZPTO testifies: despite a fairly wide range and significant results of research in the field of training workers in vocational education, numerous searches in the direction of scientific understanding of new learning technologies future workers, without the attention of researchers were left with important questions of the theoretical, methodological and methodological foundations of training future workers, in particular, the problems of organizing training in such educational institutions. First of all, it concerns the methodology of determining the purpose and content of vocational education, the relationship of goals with the content of legislative and regulatory documents, meeting the needs of the individual, society, state.

Secondly, this concerns the substantiation of leading ideas, conceptual provisions, innovative factors influencing the renewal of the content of vocational education: it is the continuity of general education in school and VES, the content of disciplines of general and special cycles in VES, integration and differentiation of vocational education content of different types.

Third, this concerns the definition of information and subject support of the educational process for the training of skilled workers, which provides not only traditional technical and printed teaching aids, but also the latest electronic information technologies based on electronic technology: creative technologies, pedagogical software, Internet and others.

Fourth, this concerns deepening of professional orientation, mastering of modern technology of extracurricular work in VES as activity which plays a significant role in mastering by pupils not only cognitive material of entertaining character, but also the material directly connected with professional training of future workers for various branches of economy of Ukraine.

In addition, propaedeutic observations of the learning process in VES of Vinnytsya and Vinnytsya oblast (region), the results of interviews

with teachers, masters of industrial training, school leaders, analysis of monographic scientific, pedagogical and methodological literature allowed to establish that these educational institutions are dominated by the following realities:

- a) as a result of acquaintance with the curricula of general, general technical and special disciplines certain interdisciplinary connections are revealed;
- b) mainly information-reproductive methods and teaching methods are used;
- c) extracurricular work is mostly spontaneous, episodic;
- d) computer technology is used sporadically, mainly to control the knowledge and skills of students, etc.

Thus, the relevance and expediency of the topic of our study are due to the increased modern requirements of society for the training of skilled, professionally literate workers in the current conditions of vocational education and lack of conceptual justification of a holistic system of theoretical and methodological foundations of training in Ukraine.

Study design.

Purpose of the research - To analyze modern trends in the design of the content of technological education and training in vocational schools; to develop and experimentally test the updated means of information-subject and scientific-methodological support of education in vocational and technical educational institutions.

Research methods are mainly diagnostic and evaluative. These are detailed in the Methods and Materials section.

Research hypothesis. We believe that the author's optimization of the effectiveness of the organization of training in vocational education institutions proposed by us will give positive results, at least in some indicators.

Carrying out a propaedeutic and ascertaining pedagogical experiment covered 17 Ukrainian schools (34 teachers, 1786 students), which were involved in the experiment by means of a continuous sample, limited only by the consent - disagreement of the participants.

Research ethics. All mediated and direct participants in the experiment voluntarily agreed to participate in it and could leave the experiment of their own free will at any time. Due to the large size of the

sample, such consent was obtained at the expense of the administration of the educational institutions.

Literature review

As practitioners, the authors of this article are well acquainted with the problems of Ukrainian scientific and methodological literature, as discussed in the previous chapter. We believe that in this chapter it is appropriate to dwell on the main modern foreign trends in vocational education.

We consider it appropriate to describe the most expressive models and problems of vocational and technical training of different countries selectively, which will demonstrate the diversity of educational policy, methodological and industrial problems in different regions.

Research over the past decade suggests that vocational education in developed countries is very different. This is due to several factors: the presence of powerful industrial sectors, the traditions of dual education, the specifics of vocational guidance work at school, etc. For example, English technical education is significantly worse in quality than German or American. Apart from a less developed industry that stimulates technical education, this is due to inadequacies in scholastic field-oriented training. In this country, the practice of vocational guidance for adolescents aged 14-16 at school is widespread, which shows a low quality of such training and has no connection with industrial practice. Now the British government is trying to rectify the situation by introducing courses that not only provide high professional training, but also offer access to further and higher education, motivated by the prospect of quality employment and satisfaction of technical activities.

A critical examination of the experience of the Organization for Economic Co-operation and Development (OECD) countries reveals a significant divergence between students' dreams of higher professional education and the social realities of employment and professional growth. In most European countries, potential vocational students (adolescents 15-16 years old) are audited in specialized classes. In the most technologically advanced developed countries (Japan, Germany), business owners, together with educational administrative institutions, carry out career guidance and pre-selection of students from the age of 10.

Ozer and Perc (2020) believe that it is necessary not only to orient and predict the future activities of young people to overcome this problem,

but also to "audit education throughout life." We also propose to restructure vocational education, reducing the degree of differentiation of curricula, allowing to expand vocational education programs and reduce the number of professions, taking into account the changing dynamics of the labor market". Thus, significant robotization, the rapid change in industrial and economic conditions, the weakening of the role of human capital require constant adaptation of the concepts and content of technical education in developed countries. It is clear that this problem concerns developing countries to a lesser extent. There is a financial inability to receive quality technology education in such countries, and the need for workers and technical personnel is high.

In his book, Ryan (1991) conducted a comparative analysis of vocational education and training in the UK and Germany. He drew parallels on the parameters of production consistency, selection transparency, and stability (Ryan, 1991). The author proves that the German model of vocational education is more effective, but in recent years there has been a total borrowing of Japanese experience from European educational and industrial practices. Such experience is largely based on the synergy of human and automated resources, as well as high technology and the operational function of the employee. Hereof we can conclude that the paradigms of regional models of vocational education depend not so much on its administration as on the technological progress of the state and its ability to abandon atavistic educational traditions.

The analysis of vocational education in Israel reveals regional problems and perspectives that can be creatively and adaptively taken into account when planning and administering the training of skilled workers in Ukraine. Among the problems, scientists cite the excessive fragmentation (clustering) of the time of vocational education and training in Israel. This causes excessive entropy both in the choice of profession by applicants and in the formulation of qualification requirements by employers. An interesting fact: this multimodality and fragmentation is observed against the background of significant economic and technological growth in Israel and, at the same time, rising unemployment, which is offset by the attraction of workers from other countries. Therefore, the problem is rather educational and organizational. Currently, scholars in economic planning and education administration are proposing "to create a single strategic body that will plan and guide and support policy development on vocational education and training within the government" (Kuczera et al., 2018). However, we have

noticed another aspect of the problem: Israeli citizens find employment unprofitable. In such conditions, pedagogy and education cannot affect the economic component, however, it is possible to increase the motivation of students through their effective actions in selective (alternative) school professional programs that will contribute to social mobility, adaptability and personal confidence and involvement in practical transformation, well-being of the country, social group, family, etc.

Spain can serve as an example of effective synergy of all interested persons in the formation of the content of vocational education and the selection of applicants. Its government took into account all previous positive experiences in vocational education and in 2013 reformed the dual model of vocational education and training “from above” (Martínez-Morales & Marhuenda-Fluixá, 2020). To date, this has yielded excellent results: a consensus has been reached between all persons - enterprises, trade unions, departments of labor and education management. Such cooperation made it possible to optimize and make modern all aspects of training vocational and technical workers: determining the essence of their professional qualifications, determining the expected learning outcomes (competencies), requirements for training curricula.

Progressive scientists (futurologists, economists, educational theorists) understand that so far total digitalization and automation of the production sphere cannot fully replace a person. Evidence of this is the growth in demand for skilled labor even after the fourth industrial (digital) revolution in the 21st century. The main force for progress of vocational education reforms in a globalized world are new quality, time and resource requirements that can be provided by universal digital transformations of such education and the maximum introduction of self-government in the educational process in the vocational education college (Rujira et al., 2020). The vocational and technical direction is easier to standardize and harmonize with the objective and practical aspects of the economy and industry, in contrast to the humanitarian areas of training. Therefore, scientists propose to introduce framework standards based on digital technologies already at the stage of training specialists in the professional and technical sphere: electronic management of colleges, maximum digitalization of the educational process, increasing the digital competence of all personnel of educational institutions, permanent remote (network) contact with enterprises, establishments and institutes, digitalization of college infrastructure and methodology (Rujira et al., 2020). In the presence

of self-initiative and self-education, the development of competencies in digital education management by all its subjects, this can be done. Unfortunately, in developing countries (and even in some developed industrialized countries) vocational education is now considered a “second class of professions”, and applicants see their career development after receiving university education. Clement (2014) investigated the measures of governments and enterprises trying to raise the prestige of manufacturing professions. These activities include image campaigns, building confidence in vocational education, and introducing alternative and promising training programs funded by interested enterprises. The scientist also outlines the disadvantages of such measures, among which the specifics of the region, social context, demography, etc. are most often ignored.

Therefore, one can observe progressive (interaction of enterprises and educational institutions, electronic management of the learning process, synergy of automated and human resources, etc.) and local destructive tendencies: a lack of workers due to a low rating of technical specialties, demographic and ethnic characteristics, excessive entropy (multimodality) of professions confuses applicants, etc.

Materials and methods

To solve the set tasks, theoretical and empirical methods of scientific and pedagogical research were used, which are used in the social sciences. Among them: theoretical (analysis, synthesis, modeling, comparison, systematization, generalization of scientific, theoretical and experimental data), empirical (questionnaires, interviews, control tests, observation, self-observation, discussion, expert ratings, pedagogical experiment, methods of mathematical statistics, computer experimental data processing).

By conducting uniform and selective tests, frontal and final qualifying exams in the control and experimental groups, a comparison was made of the effectiveness of the organization of training - the level of mastering general educational, general technical and special knowledge and skills.

To compare the effectiveness of the experiment in the control and experimental groups, we put forward a null hypothesis. Null-hypothesis is formulated as follows: the level of assimilation is the same in the control and experimental groups. This hypothesis was tested by the Pearson's chi-square test.

To experimentally test the effectiveness and efficiency of the defined principles of training in VES, we have proposed:

1. Qualification characteristics of some professions of skilled workers of electrical and radio production.
2. Curricula for the training of skilled workers in these professions in vocational education institutions.
3. Integrated curriculum (physics with the basics of electrical engineering).
4. Textbooks for students of integrated nature (physics with the basics of electrical engineering).
5. Materials to check the assimilation of general educational, general technical and professional knowledge, skills, abilities and experience of creative activity (tests, cognitive tasks, tasks with pairs of questions, etc.).
6. Methodical manuals, recommendations and instructions for teachers and masters of industrial training on the organization of the educational process in the classroom and in extracurricular activities.
7. Pedagogical software for conducting classes on new information technologies using multimedia tools.

Under the conditions of a level approach to the assessment of students' knowledge, we have identified four types of educational activities: reproductive, reproductive-exploratory, productive and creative. We used the four-level classification of Bezpalko (1995) and created a classification of levels of learning not only subject knowledge and skills, but also the relevant elements of information of an integrated nature in accordance with the cycles of disciplines studied in VES.

During the experiment, much attention was paid to the activation of students' mental activity, the development of their independence. The educational process was conducted so that the acquisition of knowledge, skills, abilities and experience of creative activity was the result of independent mental and practical actions of students. To this end, students were offered the following types of independent work: to derive simple formulas that characterize the operation of devices, apparatus, machines of direct and alternating currents, electrical circuits and networks; drawings of diagrams, graphs and vector diagrams, work with existing models of devices and electrical circuits (assembly of circuits, readings on the scales of devices, recording characteristics); reading the relevant material in the textbook, etc. Visual aids and traditional technical teaching aids were widely used during classes.

In the control groups, the approach to the organization of training remained traditional.

In the experimental groups, for the organization of training we have identified the personality models of a skilled worker, qualification characteristics, curricula, programs, manuals for students and teachers of an integrated nature. New information technologies based on the use of personal computers and multimedia tools were widely used during the training. Extracurricular work in general education, general technical and special disciplines, which was carried out according to our methodology, was systematic, its content was focused on the professions that are mastered by students of VES.

During the pedagogical experiment, special attention was paid to the objectivity of assessing student performance, attitude to learning, interest in learning a subject and mastering the profession, the creative approach of students to educational work and more. Hence the identity of the applied criteria and the comparison of the same indicators.

We resorted to a long comprehensive experiment, the duration of which in the same groups lasted from one to three years (from the first to the third year).

The experiment was conducted in institutions of vocational education № 4, 11, 19 of Vinnytsya, which train skilled workers in electrical and radio professions: regulators of radio and television equipment; PC operators; radio mechanics for maintenance and repair of radio and television equipment, machinery, etc. The experimental study (previous and main - for six years) involved about 2,000 students, teachers and masters of industrial training VES.

In order to avoid mistakes, due to the different level of pedagogical abilities and practical training of teachers, the following categories of experimenters were involved: experienced teachers and masters of industrial training with significant experience; young teachers and masters of industrial training from among the graduates of Vinnytsya State Pedagogical University named after Mykhailo Kotsyubynsky (Ukraine); full-time and part-time students.

First, a preliminary pedagogical experiment was organized. It was attended by students who mastered the profession of electrical and radio engineering (VES № 4, 11, 19 of Vinnytsya). Two experimental and two control groups were formed in each school (6 experimental and 6 control groups in total). At this stage of the study, the task was to pre-test the

effectiveness of our proposed organization of training in vocational education institutions.

During **the main** experiment, the effectiveness of the developed system of training organization was carefully checked. It was held in two Vinnytsya VES's - № 4 and № 11. It was attended by 8 experimental and 8 control groups, whose students mastered the same professions of electrical and radio engineering profiles.

In the experimental and control groups, considerable attention was paid to the activation of students' mental cognitive activity, the development of their independence. The educational process was conducted in such a way that the acquisition of knowledge, skills and abilities was the result of independent mental and practical actions of students. To this end, we offered students the following types of independent work: to derive simple formulas that characterize the operation of devices, apparatus, machines of direct and alternating currents, electrical circuits and networks; drawings of diagrams, graphs and vector diagrams, work with existing models of devices and electrical circuits (assembly of circuits, readings on the scales of devices, recording characteristics); reading the relevant material in the textbook, etc. Visual aids, traditional and the latest technical teaching aids were widely used during classes.

For the experimental groups, original qualification characteristics of future workers, appropriate curricula, programs, manuals of students and teachers of an integrated nature were developed.

The main feature of the experimental technique was that its implementation was not accompanied by the allocation of additional time for certain types of classes. The educational process in the control groups was carried out within the existing, and in the experimental groups - according to the developed curricula and programs. The pedagogical experiment was carried out in lessons and in the process of extracurricular work in natural sciences, mathematics and vocational disciplines. For its implementation, significant preparatory work was carried out to create appropriate didactic support for experimental training.

Teachers in the experimental groups were guided by the experimental program developed by us, used identical methods and techniques.

- The program of experimental work contained the following stages:
1. Acquaintance of teachers and masters of industrial training with:
- qualification characteristics of specialists;

- curricula of the profession;
- curricula of certain disciplines;
- educational literature on natural-mathematical and professional-technical disciplines.

2. Drawing of planning documentation of the teacher or the master of industrial training on the basis of the comparative analysis:

- curricula;
- training programs;
- textbooks and manuals, collections of tasks, tasks and exercises.

3. Coordination by teachers and masters of industrial training of questions of identity of elements of knowledge in various subjects, possibilities of integration and differentiation of educational material, forms and methods of training of pupils.

4. Analysis of the possibilities of new information technologies of training during individual classes, taking into account:

- available training facilities (computers, multimedia);
- availability of pedagogical software;
- preparedness of teachers and masters of industrial training for the introduction of new information and digital technologies.

5. Selection of effective forms of extracurricular activities and activities of students (individual, group and mass).

6. Developing of tests, control tasks, tasks and questions of a practical nature to verify students learn how to use the necessary educational information and how to use it during lessons.

7. Direct experimental work.

When developing tests to test students' knowledge, skills and abilities, we strived for a relatively short duration of their implementation by all students in the group, unambiguous and concise answers, convenience for mathematical and statistical processing of results.

For experimental work, a variety of test tasks was developed that took into account the types of tests developed in the psychological and pedagogical literature. In addition to test tasks, other types of tasks were used during the experiment. First, these are cognitive tasks for independent work of students. They were faced with the following requirements:

a) the content of the tasks must fully correspond to the content and curriculum, its goals and objectives;

b) it is necessary to achieve organic unity of cognitive tasks and other forms and methods of educational activity (presentation of material by the teacher, use of information means, test control, etc.);

c) finally, the whole set of cognitive tasks must meet the requirements of the system of tasks, first of all, the complexity of the tasks and the degree of independence that the student will show, must increase.

We did not limit ourselves to such methods of verification, but also used other methods of measuring the effectiveness of training, including those developed by the authors. These are tasks that include two or three questions and test students' mastery of the relationship between general, technical and special subjects. After that, the planning documentation of the table, plan-maps, reporting-thematic plans, network schedules, etc. were compiled.

The effectiveness of students' education, i.e. the diagnosis of the proposed system of organization of the educational process in vocational schools, was determined by means of tests and practical tasks. In addition to the current test of knowledge, skills and abilities of students, which was discussed above, during the experiment, a thematic test of professional knowledge and skills of future skilled workers was practiced. The main criteria is the quality of students' mastery of the system of interconnection of knowledge in physics, electrical engineering and special subjects, which were formed in each lesson, a specific topic and subjects in general.

Results

To determine the performance of students in the control and experimental groups, we not only compared performance for the academic six months or the academic year, but primarily used the comparison of the number of correct and incorrect answers to the problems of diagnostic sections. This comparison was carried out during each academic year, assessing the study of specific topics, sections and individual disciplines.

To determine the acquisition of knowledge and skills as an effective form of cognitive activity of students for each educational topic, a set of elements of knowledge was singled out, including actual knowledge of individual theoretical positions, practical skills to operate them in the process of performing exercises, solving problems and tasks of a practical nature.

The number of such elements was determined according to the requirements of the curriculum, so it is quite understandable that in different topics, sections and subjects a different amount of knowledge was subject to

verification. Using the number of elements of acquired knowledge as an indicator of student learning efficiency, we obtained homogeneous information about knowledge on each topic, section or subject of all students participating in the experiment.

Table 1 shows data on the strength of the acquisition of educational material by students in the preliminary and main experiment on the main subjects that form professional training.

Analysis of the data in Table 1 makes it possible to establish the presence of statistically significant differences in the case when the indicators are determined in percentages, indicate the presence of significant differences in the strength of the acquisition of knowledge by students of the experimental and control groups. The relative amount of the number of parts of the learned knowledge to the total in the experimental groups exceeds the analogous characteristics for the control groups with a reliability of 95-99.7%. This confirms the advantage of the highly traditional experimental methodology for organizing training in vocational schools.

Table 1. The strength of the acquisition of knowledge by students of the control and experimental groups

	Previous experiment (1990 - 1993)		Basic experiment (1993 - 1996)	
	control (n^I_1)	experimental (n^{II}_1)	control (n^I_2)	experimental (n^{II}_2)
The number of students who participated.	172	171	232	234
Acquisition rate	K^I_1	K^{II}_1	K^I_2	K^{II}_2
Physics	0,66	0,78	0,68	0,84
Electrical engineering	0,70	0,84	0,72	0,86
Special technology	0,82	0,92	0,82	0,94
Industrial training	0,86	0,96	0,86	0,98

Systematized by the authors

During the analysis of the results of testing the knowledge, skills, abilities and experience of creative activity of students, we conditionally identified four categories of students' answers.

Achieving level I (answer categories IA, IB and IC) indicates that students have mastered, respectively, the actual material from general education (physics), general technical (electrical) and special (special technology) subjects.

Level II (answer categories IIAB, IIBC, IIAC) corresponds to the degree of mastery of interrelated knowledge in these subjects (physics-electrical engineering, electrical engineering - special technology, physics-special technology), when students remember this connection from the teacher's story or from textbook text and understand it.

Level III (answer categories IIIAB, IIIBC, IIIAC) involves the ability of students to use interrelated knowledge of these pairs of subjects in practice to solve cognitive problems of theoretical or practical nature.

Level IV (IVABC answer category) is a level of integration, synthesis of knowledge from three disciplines with the ability to transfer, transform knowledge from one or two subject areas to others. Achieving this level demonstrates the ability of students to combine knowledge from different subjects, to use them creatively in practice.

In order to identify the level of acquisition of educational information, control works were used, which included three types of tasks (performance tests, cognitive tasks for independent work; tasks consisting of two questions). We compiled a table of students' acquisition of information on categories I_A, I_B, I_C, II_{AB}, II_{BC}, II_{AC}, etc. based on the results of tests. Its lines are filled in according to the results of control works. We calculate the absolute and then the relative (in%) the number of correct answers on a given topic, section or discipline, corresponding to each of the levels I, II, III, IV.

Table 2 compiled in this way allows us to compare the level of acquisition of the system of knowledge in physics, electrical engineering and special technology and, on this basis, the quality of knowledge of students (the basic experiment). The possibility of using the relationship of knowledge at the level of reproduction is slightly higher in the control groups. However, the creative use of the relationship of knowledge in control works is significantly higher in the experimental groups. This indicates that the students of the experimental groups have mastered knowledge of various subjects better and use it to solve practical problems and tasks. At the same time, students in control groups predominantly reproduce only the information that they have memorized from a teacher's story or a textbook. Finally, the students of the experimental groups gave

significantly higher rates of mastering the educational material at level IV, that is, the levels of integration of the relationship of knowledge from three cycles of disciplines.

Table 2. The acquisition of educational information by students by levels and categories

Examine	Category of acquisition of educational information	The results of the control works (the number of correct answers in% of the total number)					
		Physics (A)		Electrical engineering (B)		Special technology (C)	
		control	experimental	control	experimental	control	experimental
Knowledge of physics material	I _A	70,6	75,4				
Knowledge of material in electrical engineering	I _B			76,2	79,8		
Knowledge of the material on a special subject	I _C					87,2	90,8
Using the relationship of knowledge at the level of reproduction	II _{AB}	10,8	36,3	54,1	44,7		
	II _{BC}			42,6	39,4	56,5	47,8
	II _{AC}	20,8	19,4			36,2	30,4
Creative use of the relationship of knowledge and skills	III _{AB}	18,4	32,8	26,9	44,7		
	III _{BC}			24,9	37,1	31,8	45,4
	III _{AC}	14,6	28,2			20,8	34,3
Using knowledge interconnection at the level of integration	IV _{ABC}	12,9	29,4	26,8	43,6	39,8	57,3

Systematized by the authors

As can be seen from the table, the efficiency and quality of acquisition of knowledge of an integrated nature in the experimental groups is much higher than in the control groups. Let us present the data

characterizing the acquisition of the relationship of knowledge by the students of the experimental and control groups according to the selected levels (Table 3).

Table 3. Average characteristics of students' performance of tests

Study groups	Achievement of tests (correct answers in% to the total number) by categories									
	I _A	I _B	I _C	II _{AB}	II _{BC}	II _{AC}	III _{AB}	III _{BC}	III _{AC}	IV _{ABC}
Experimental	75-78	84-86	86-91	19-26	29-34	44-48	28-31	40-42	45-49	55-57
Control	70-73	79-83	84-87	21-26	28-33	46-50	14-16	22-24	29-31	14-18

Systematized by the authors

Based on the above data, we formulate the null hypothesis in our case as follows: the level of acquisition is the same in the control and experimental groups. The hypothesis was tested according to the goodness-of-fit criterion χ^2 :

$$\chi^2 = \frac{N(m_{11} \cdot m_{22} - m_{12} \cdot m_{21})^2}{n_1 n_2 (m_{11} + m_{21})(m_{12} + m_{22})},$$

m_{11} i m_{21} – the number of correct answers in the control and experimental groups, respectively;

m_{12} i m_{22} – the number of wrong answers in the control and experimental groups;

$n'_1 = m_{11} + m_{12}$ – number of students in control groups (previous experiment);

$n''_1 = m_{21} + m_{22}$ – number of students in experimental groups (previous experiment);

similarly n'_2 i n''_2 – the number of students in the control and experimental groups (basic experiment);

$q = k - S$ – number of degrees of freedom, $k=2$ – number of compared frequencies, and $S=1$ – the number of links that are superimposed on these frequencies, i.e. $q = 1$.

The results indicate statistically significant differences in the acquisition of educational material by students of the experimental and

control groups at levels III and IV. The reliability of the results when denying the null hypothesis in the previous and main experiment is 95 - 99.9%.

At the same time, both in the previous and in the basic experiment, there are no significant differences between the acquisition of educational material at levels I and II. The null hypothesis should be accepted at a significance level between 0.1 and 0.9. This means that the excess of indicators in the experimental groups over those in the control groups, or vice versa, is random.

Therefore, the results of the experiment showed that in the control groups it is preferable to master the educational material at levels I - II, and in the experimental groups it is typical to master knowledge in related disciplines at levels III - IV. Thus, by checking the pedagogical capabilities of the proposed organization of training in vocational schools, it was confirmed that such an organization of the educational process ensures high results in the training of future skilled workers in vocational schools.. These are the consequences of an experimental test of the effectiveness of the organization of teaching students in vocational schools. All of them proclaim in favor of the widespread introduction of such an organization of the educational process.

The results indicate statistically significant differences in the acquisition of educational material by students of the experimental and control groups at levels III and IV. The reliability of the results when denying the null hypothesis in the previous and basic experiment is 95 - 99.9%.

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Discussion

The article confirms the opinion of Hansen (1995) about the two-stage involvement of an applicant in obtaining a professional education (first, overcoming a number of prejudices, and then gaining professional socialization), which means a motivational-value correction of a young personality.

The results of the study correlate with modern concepts of vocational education, according to which technological knowledge is not permanent, and training is completed. The main task of students in vocational schools is to acquire “ways of acquiring knowledge and operating rules”. This should be complemented by training technicians for a variety of possible industrial and social events and situations, personal openness to new data.

The scientific novelty of our research results is that:

- for the first time the concept and model of the organization of training in VES establishments on the basis of ideas of continuity, integration and differentiation of the maintenance of education are theoretically substantiated and developed;

- the theoretical bases of the basic conceptual and terminological device of subjects developed by us in the maintenance of preparation of skilled workers are defined;

- theoretically substantiated and practically implemented recommendations for the creation of educational literature of an integrated nature for students and teachers of VES; created an integrated textbook "Physics with the basics of electrical engineering", pedagogical software for computer support of the educational process;

- theoretically and experimentally substantiated the technology of realization of interdisciplinary connections in teaching, integration of students' knowledge from different cycles of subjects;

- the technique of use of new information and digital technologies of training on the basis of electronic equipment is offered;

- further development of the provisions on the systematic updating of the content, methods, forms of organization of extracurricular activities as an effective factor in the development of creative abilities of students VES and prepare them for work in modern production.

The scientific and methodical significance of the work lies in the fact that:

- the conceptual provisions on updating the content of education and training in VES are substantiated, its influence on the formation of the personality of the future qualified specialist is revealed;

- the principles of organization of education in vocational and technical educational institutions are substantiated;

- revealed patterns of formation of the creative personality of the student in learning, ways to improve this process;

- the theoretical bases of application of innovative technologies for creation of a methodical system of maintenance of educational process are developed and proved;
- criteria for selection of educational material of general education, general technical and special subjects are developed;
- the main prognostic directions of development of vocational education institutions are determined on the basis of the revealed tendencies of development of educational systems in Ukraine and other countries.

Conclusions

The analysis of the state of the researched problem of organization of training of pupils in Ukrainian VES establishments has shown that in scientific and pedagogical and methodical literature it is considered incompletely: the purpose and tasks of each stage of process of training are vaguely defined, there is no uniform methodology pedagogical categories of education, only partially defined criteria for selecting the content of educational material, in its infancy is the problem of implementing creative information technologies in education, etc. Therefore, at the present stage of development of vocational (technical) education in Ukraine of particular importance is the search for effective organization of the learning process, identifying those stages in it that affect the general, technical and vocational training of future skilled workers.

Analysis of foreign literature on regional models of vocational education provides rich material for the reform of Ukrainian education. If the state has not yet established a system of dual education, the training of skilled workers should be carried out in a practical learning environment. At the same time, competencies and practical skills should be guided by two perspectives: high-quality performance of professional tasks and the formation of the latest knowledge and skills necessary for employment in a rapidly changing environment. Such principles are adhered to by technology education methodologists from leading industrial countries (Joyce, 2019). Recently, these countries are trying to quickly exchange innovative technologies between enterprises and educational institutions, as well as to optimize the quality of technological education in the following areas: improving the quality of education, accelerating the pace of obtaining qualifications, transparent and direct financing, ensuring access to education for people with low social economic potential, improving information about the prospects of blue-collar occupations.

It can be concluded from a brief overview of foreign trends: it is necessary to integrate management institutions, enterprises, educational institutions in the training of professional and technical workers; self-initiative of institutions, motivation of employees for self-education and lifelong learning and electronic management of the educational process give good results. Despite this, the world has regional problems of vocational and technical staffing: multimodality and fragmentation of specializations, unemployment, low prestige of blue-collar occupations, traditional prejudices towards vocational education, disorientation of applicants, etc.

As for the second part of the goal stated in the article, some generalizations can be made. The main provisions of the concept of organization of training in vocational schools are determined by the needs of flexible regulation of the labor market, meeting human needs in education and the development of its social initiative and responsibility.

On the basis of the theoretical and methodological substantiation of the provisions of the concept of organizing training in VES, the author's aspects of organizing training in VES have been developed and their effectiveness has been comprehensively tested in the framework of the experiment. Unfortunately, within the framework of the article, we cannot explicate the meaningful essence of the model under consideration, but we note that the following were subject to verification:

- ways and means of realization of continuity of the maintenance of education and the maintenance of training, and also technologies of training in establishments of vocational education;

- components of integration of education in educational institutions as a didactic equivalent of the relationship of social, natural and technical sciences at three levels;

- differentiation of the content of training in VES, which reflects the presence of different levels of learning, as well as a variety of methods and organizational forms of training;

- didactic content of education and training in schools of electrical and radio engineering profiles, as well as its structuring;

- educational and methodological documentation and literature for the training of skilled workers in the professions of electrical and radio engineering production (curricula, programs, textbooks and teaching aids, guidelines for engineering and teaching staff, etc.). The main object of the test was the performance of students in certain conditions.

The generalized results of the conducted researches testify to efficiency of the theoretical and methodical bases of the organization of training in VES offered by the author. Experimental data give reason to believe that the initial methodology is correct, the identified tasks are implemented, the goal is achieved, the set of formulated scientific conclusions is important for the theory and practice of training qualified specialists in VES.

It was found that there are no significant differences between the acquisition of educational material in the control and experimental groups at levels I and II. The null hypothesis should be accepted, since the excess of the percentage reflecting the number of answers to the content of control works in the control and experimental groups at levels I and II is random - with a confidence level of 95-98.7%. At the same time, the percentage indicators reflecting the number of correct answers for levels III-IV in the experimental groups exceed those for the control groups with a reliability of 95-99.9%, that is, the null hypothesis in this case cannot be accepted.

Therefore, it is typical in the control groups to acquire knowledge in related disciplines at levels I and II, and in the experimental groups at levels III-IV.

The examine of the pedagogical capabilities of the proposed organization of training in the VES has been confirmed that it provides high results in the training of qualified specialists in vocational education institutions. These are the consequences of the experimental verification of the effectiveness of the organization of training students in the VES. This confirms the usefulness of widespread implementation of the organization of the educational process which we offer.

Experimental data give reason to believe that the initial methodology is correct, certain tasks have been implemented, the goal has been achieved, the set of scientific conclusions formulated is important for the theory and practice of training qualified specialists in the labor market.

The limitation of the study consists, first of all, in the fact that the authors could not fully present the author's methodological material, but only selectively described the organization of the educational process. The authors also note that the relevance and effectiveness of the results concerns countries with a transitional credit-transfer educational system (mainly the post-Soviet republics).

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