Improving the Practical Activities of Students in the Course «Power Sources For Welding»

A.Y. Krasnopevtsev, Z. V. Smirnova, O.I. Vaganova, M.M. Kutepov, L.I. Kutepova, E.V. Lukina

Nowadays vocational education has undergone a number of significant changes which were the result of serious socio-economic changes in society as well as integration processes in European educational space. In modern education, practical classes began to occupy a significant part of the time of students' education. Therefore, an objective need arose in making changes to the existing system of vocational education, which will meet modern requirements for training highly qualified specialists. In the context of increasing importance of the practical part of education, the authors emphasize the need to focus attention on the practical work of engineering students as one of the most popular specialties of secondary vocational educational institutions which actualizes consideration of this issue in the work. The purpose of the article is to consider the improvement of practical work in the course "Power sources for welding" as fundamental in the training of welders. The authors developed a practical lesson in this course which is accompanied by appropriate detailed recommendations on the implementation of tasks. Improving students' practical activity is an integral part of college successful functioning because within the framework of the competence-based approach, the training system must be transformed and adjusted to the requirements of the new Federal State Standard. Guided by the results obtained during the study, we concluded that this development can be used in the further process of teaching students in technical colleges in the city of Nizhny Novgorod.

***Index Terms*: *teacher, secondary vocational education, practical work, practical lesson, educational process, students*.**

I. INTRODUCTION

One of the most important tasks of vocational education system is to ensure high level of educational services through compliance with the requirements established by the Federal State Educational Standards. For this, educational institutions look for various ways of teaching students, choosing the most effective ones. [10], [12] Since modern vocational education focuses on increasing the proportion of practical work of students, there is a need to improve this particular side of vocational education. [4] The society needs graduates who are ready to be promptly included in professional activities, capable of creatively solving professional issues facing them immediately after graduation from college. [15] Their readiness depends not only on acquired knowledge and skills, but also on competencies development. It is the practical activity during the training that contributes to better development of general cultural and professional competences. [16] Improving the practical activity of students in the course "Power sources for welding" allows us to form the fundamental knowledge and skills for the future activities of the welder. [18] The course "Power Supply for Welding" is an educational special course that establishes basic knowledge to gain professional knowledge and skills, is based on the knowledge gained by students in the study of electrical engineering with the basics of electronics, standardization, and certification courses: "Production of welded structures" and "Equipment, mechanization and automation of welding processes". [1] As a result of studying the discipline, the student should: have an idea of the main trends and directions of development of modern welding equipment; about the main scientific and technical problems and prospects of development in the field of welding production, their interrelations with adjacent fields of science and technology; know: the properties of the welding arc of direct and alternating current and its current-voltage characteristic; power supply requirements; classification and designation of power sources, automats and welding equipment; design, principle of operation and scope of power sources, automata and welding equipment; be able to: choose the power sources of the required power; remove the voltage-current characteristic of power sources; select the parameters of the welding machine in accordance with the selected power source; determine the parameters of semi-automatic and automatic machines; calculate the permissible current of the power source; use reference and regulatory literature; choose automatic, semi-automatic, welding equipment that meets the requirements of the technological mode with the highest efficiency. [3] The purpose of the course "Power sources for welding" is to study the physical essence of the phenomena occurring during the operation of each type of welding equipment. [15] As we see, the course contains many elements, without which the passage of the further learning process will be difficult, therefore it is necessary to find a way to build a practical lesson that would allow students to develop necessary competencies.

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A.Y. Krasnopevtsev, Federal State Budget Educational Institution of Higher Education «Togliatti State University», Togliatti, Russian Federation.

Z. V. Smirnova, Minin Nizhny Novgorod State Pedagogical University, Nizhny Novgorod, Russian Federation.

O.I. Vaganova, Minin Nizhny Novgorod State Pedagogical University, Nizhny Novgorod, Russian Federation.

M.M. Kutepov, Minin Nizhny Novgorod State Pedagogical University, Nizhny Novgorod, Russian Federation.

L.I. Kutepova, Minin Nizhny Novgorod State Pedagogical University, Nizhny Novgorod, Russian Federation.

E.V. Lukina, Minin Nizhny Novgorod State Pedagogical University, Nizhny Novgorod, Russian Federation.

II. LITERATURE REVIEW

Practical work is an activity connected with the education of the future professional welder's thinking. [19] Any type of occupation that creates conditions for the emergence of independent thought, cognitive activity of students is associated with practical work. Many authors note that in a broad sense, practical work should be understood as the totality of all independent activities of students both in and outside the classroom, in contact with the teacher and in his absence. [14], [24] The main thing in the strategic line of organizing the practical work of students in a college is not to optimize its individual types, but to create conditions for high activity, independence and responsibility of students in and outside the classroom during all types of educational activities. [23] The goal of practical work is to teach the student to work intelligently and independently, first with educational material, then with scientific information, to lay the foundations of self-organization and self-education in order to instill the ability to further continuously improve their skills. [6] We consider that practical work within the framework of studying the course should be aligned with dynamic changes caused by radical political and socio-economic reforms. [5] At present, dozens of specialized sites and welding workshops have been organized, where the most efficient welding methods are successfully applied, and welding itself has become an important and independent technological process. [20] Researchers in this field note that the productivity of currently used welding methods can be greatly enhanced by mechanization and automation of auxiliary operations, as well as by improving welding equipment. [9] Improving equipment for butt welding with heated tools is aimed at creating effective automatic control of welding processes and developing specialized heating tools to increase the area of welding and extend the range of optimal welding temperatures, which is especially important for PVC products. [21] Acquaintance of students with these provisions is extremely necessary, therefore, practical classes must be attended by current professionals who can more fully disclose the essence of activities and features of this professional sphere. [13] "Power sources for welding" is a fundamental course in the process of preparing a welder - this is a technical discipline that develops knowledge of welding power sources. [8] Studying welding power sources, the future specialist should have knowledge of the types of welding equipment. [2] "Power sources for welding" is an applied science dealing with welding equipment, studying it, students should have good memory, an eye meter, concentration and attention span to remember specific material characteristic of welding production. [7] Practical training on welding power sources serves as an addition to the lecture course, which is a logical continuation of technological disciplines taught to students of the specialty of the Welding Production profile. According to the curriculum, the lecture course is 30 hours. During this time, you can briefly outline the design and operation of various power sources for welding. In this regard, practical exercises focus on constructive and technical characteristics, methods of controlling sources for electric welding, possible malfunctions, troubleshooting, safety and maintenance of power sources for arc welding, which are available in training workshops PU number 49. Since only 30 hours are allotted for practical training, some work, for example, on the physical nature of the phenomena occurring during the operation of power sources, has to be shown directly during welding. [17] The correct formulation of practical classes in this course helps the formation of a modern specialist in welding production, expands his general theoretical outlook and gives him much-needed engineering and pedagogical knowledge for his practical work as a teacher of professional training and in the field of welding. [11] High-quality practical work is a situation where students, based on their own opinions and views of mentors, work through the problem and find solutions. And methodical instructions for practical work make it possible to significantly improve the educational process, because they have a number of advantages over other methods of knowledge control; being a mandatory part of many pedagogical innovations, they reduce the cost of knowledge testing, help to identify the individual pace of learning, as well as gaps in current and final training. In addition, methodological instructions allow you to establish self-control - the most useful for learning and humane form of knowledge control.

III. METHODOLOGY

The paper presents a study to test effectiveness of practical training developed by us and the corresponding recommendations on the subject "Power sources for welding" and introduced into the activities of College No. 49 in Nizhny Novgorod, which contributes to the best formation of students' competencies. We analyzed the test records, the data of which allowed us to identify the average score for 2015, 2016, 2017, 2018. Our development was introduced in 2018. The results for the previous year were much lower (in 2015, the average score was 4.1, in 2016 - 4, in 2017 - 3.9). In 2018, the average score is 4.5. We also interviewed two groups of students-future welders (40 people). They were asked to answer the question "Has your understanding of the material improved after the introduction of improved recommendations for completing assignments?". 80% of respondents gave a positive response.

IV. ANALYSIS AND DISCUSSION

Based on the analysis of the special literature, we developed a practical lesson in the discipline "Power sources for welding", as well as methodological recommendations on the performance of work. Table 1 presents the topics of practical classes and the number of hours spent studying them, within which the course is studied. [22] Practical work "Study of the welding transformer TDM - 205U2" The purpose of the work is to get acquainted with the purpose and design of the welding transformer TDM-205U2, its technical characteristics, device, principle of operation and its maintenance.

Table 1 Workshops

No. p / p	Discipline section	Number of hours ichest	The name of practical classes
1.	Welding transformers.	12	The study of the constitution of transformers of various types.
2.	Welding rectifiers.	6	Study of rectifier ARC-318
3.	Welding inverters	12	Device of inverters PDG-204 and TIG-180
4.	Equipment for mechanized welding	5	The study of the semi-automatic A-1230M
5.	Automatic welding equipment	5	The study of the TC-17M-U
	Total	40	

Table 2 presents the technical characteristics of the transformer in question.

Table 2 Main technical characteristics of TDM-205U2

	Parameter name	Norm
1.	Rated mains voltage, V	220,380
2.	Rated welding current, A	200
3.	Limits of welding current regulation, A	40…200
4.	Rated load duration	
5.	(PN *), with a welding cycle of 5 minutes, not less than,% at current 200A at current 150A at current 100A	 40 60 100
6.	Idling voltage, V no more	 80
7.	Welding current regulation	Smooth
8.	Power consumption, kVA, not more	7
9.	Overall dimensions, mm Weight AL / Cu, kg, not more	410x420x440 44/38

PN * - the ratio of the duration of the inclusion of the load to the duration of the welding cycle, 5-minute welding cycle. Figure 1 shows a detailed diagram of the transformer. The transformer is a mobile unit with natural air cooling in a single- package design, providing them with an alternating current welding process. The transformer TDM - 205 U 2, depending on the modification, provides various options for connecting the mains voltage: 220V, 380V, or a combined 220 \ 380V. The transformer magnetic core is assembled from electrical steel sheets with a thickness of 0.5 mm and is made in the form of a spackle construction.

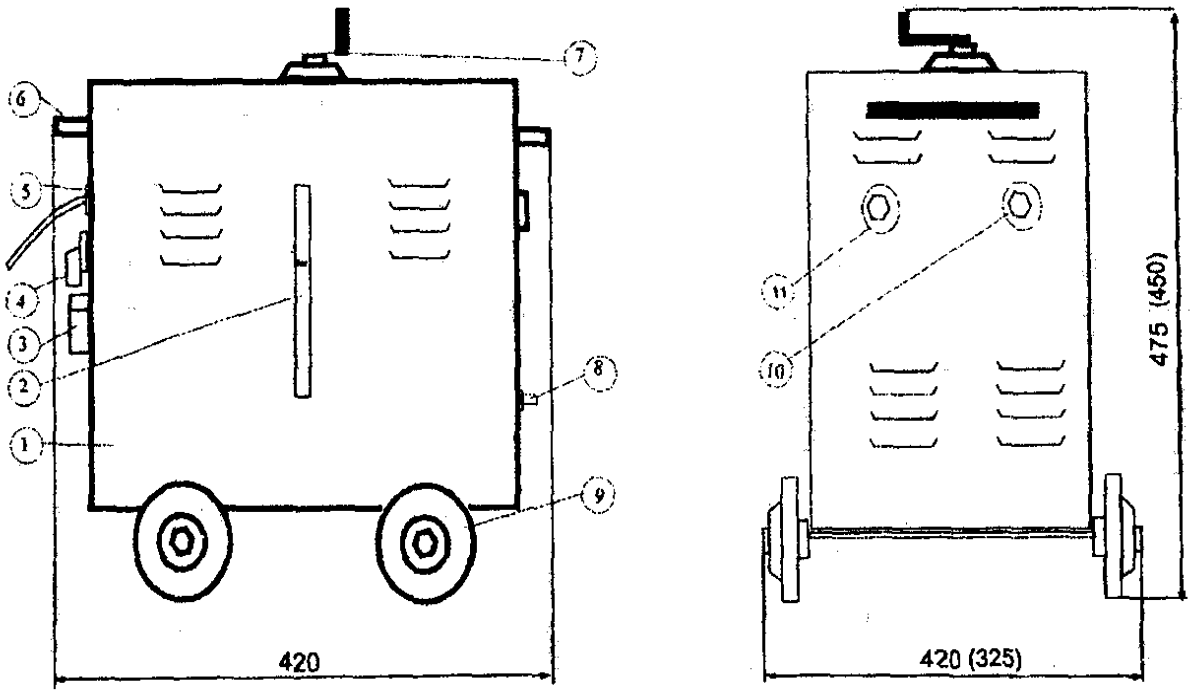

Figure 1 Diagram of a transformer TDM-205U2.

In the figure, under figure 1, the case is shown, 2 is the welding current indicator, 3 is a 220 volt PSE socket for connecting power tools, 4 is a 220-0-380 switch or circuit breaker, 5 is the input of a network cable, 6 is a transport handle, figure 7 represents the welding current regulator, 8 is the grounding bolt, 9 is the shipping wheels, 10 is the panel connector to the product, 11 is the panel connector to the electrode, 12 is the holder. For an approximate selection of the welding mode depending on the thickness of the material being welded and the diameter of the electrode, you can use the parameters recommended in Table 3.

Table 3 Mode Options

Thickness of the welded material, mm	Electrode diameter, mm	The strength of the welding current, A
1.0 …… ..2.0	2.0	60 …… .90
2.0 …… ..4,0	3.0	90 …… .140
3.0 …… ..5.0	4.0	140 …… 210
5.0 …… ..8.0	5.0	210 …… 270
8.0 …… ..14.0	6.0	250 …… 320

Before the start of classes, the teacher must conduct a safety instruction for working with a transformer. The power cable (cord) connection to the network (and its disconnection) should be made by holding the plug case. Monitor the correct indication of the lamps "network" and "welding" and its compliance with the mode of operation. To protect the eyes from the light radiation of an electric arc, it is necessary to use a protective mask or light shield. Ensure that no foreign objects are caught in the equipment that could cause a short circuit or a machine failure when it is turned on. It is prohibited: to allow unauthorized persons to work on the machine; clean the machine without disconnecting it from the mains; clean the welding sponge and stand with your hands or other metal objects; self-repair and repair work. Preparation of the transformer to work. Before using the transformer, it is necessary to organize a post for its connection (switchboard); before the first start-up of the transformer it is necessary to clean it from dust; check the 1000 watt megohmmeter with the insulation resistance of the windings; make all the connections with the cable of the appropriate section and tighten all the terminals; ground the transformer; check the health of electrical wires and contacts; check the compliance of the mains voltage with the voltage specified in the passport of the transformer and on its case. In order to prevent the machine from malfunctioning due to overheating of the power transformer windings, the continuous arc time of the welding arc should be limited. Therefore, the student must alternate between periods of welding and rest. Reversible wire cross-sections for connection: copper at least 4 mm2; to the copper welding network copper welding cable with a section of 35-50 mm2. Practical work is a type of training activity that is held in a specially designated room.

Lessons last at least two hours. In addition to the independent work of students, instructing instructors is also necessary, as well as a joint discussion of the work done. Before starting practical exercises, students need to repeat the theory. Each practical work and practical lesson must comply with the necessary guidelines developed in approved educational institutions.

The law of electromagnetic induction.

What is mutual induction, self-induction and their use in welded equipment.

What are PN and PV electrical installations?

What is provided in the transformer to protect the welder from electric shock?

How to prepare the transformer for operation?

What is the maintenance of a transformer?

Practical task.

On the basis of the available data: decipher the designation TDM-205U2; write down the main specifications; perform the basic electrical circuit TDM-205U2; record the device of the transformer and its principle of operation

Practical work includes: theoretical part (the student is acquainted with the basic technical characteristics of the equipment, with its device and principle of operation; it acquaints itself with the basic reference indicators of the equipment); the practical part (the student is preparing the welding transformer for work; performs the procedure for equipment maintenance; assigns the parameters of the welding process); report on the work (the student summarizes the conclusion on the purpose and design of the welding transformer TDM-205U2, its technical characteristics, device, principle of operation and its maintenance). In order to test the effectiveness of the practical training developed by us, which meets the requirements of the Federal State Educational Standard, which contributes to the best formation of students' competencies, and the implementation of relevant recommendations for the implementation of practical work, we analyzed the test records, which allowed us to identify the average score for 2015, 2016, 2018 years. Note that our development was implemented in 2018. Figure 2 presents the results.

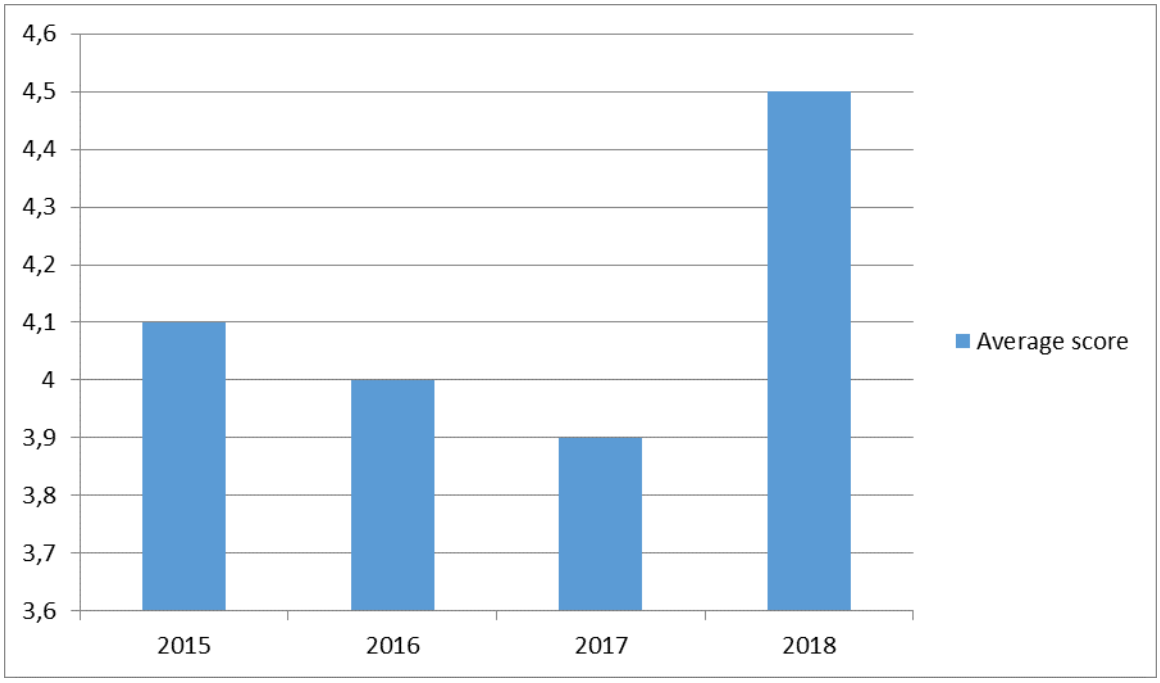

Figure 2 The results of the test of grade records of graduates who studied in the specialty "Welder"

As we can see, the average score in 2018, compared with previous years, has increased significantly. Since 2015, the average score has become lower, so appropriate measures were required. Since the introduction of recommendations for the implementation of practical work, students have begun to approach the implementation of tasks more responsibly. And this, in turn, suggests that students learn more deeply the material and more successfully master the relevant competencies. Consequently, by the time they are released, they will be better prepared to carry out their professional activities. Also, we interviewed the students themselves, "Has your understanding of the material improved after the introduction of improved recommendations for completing assignments?" 40 students took part in the survey (2 groups of students). Figure 3 shows the results.

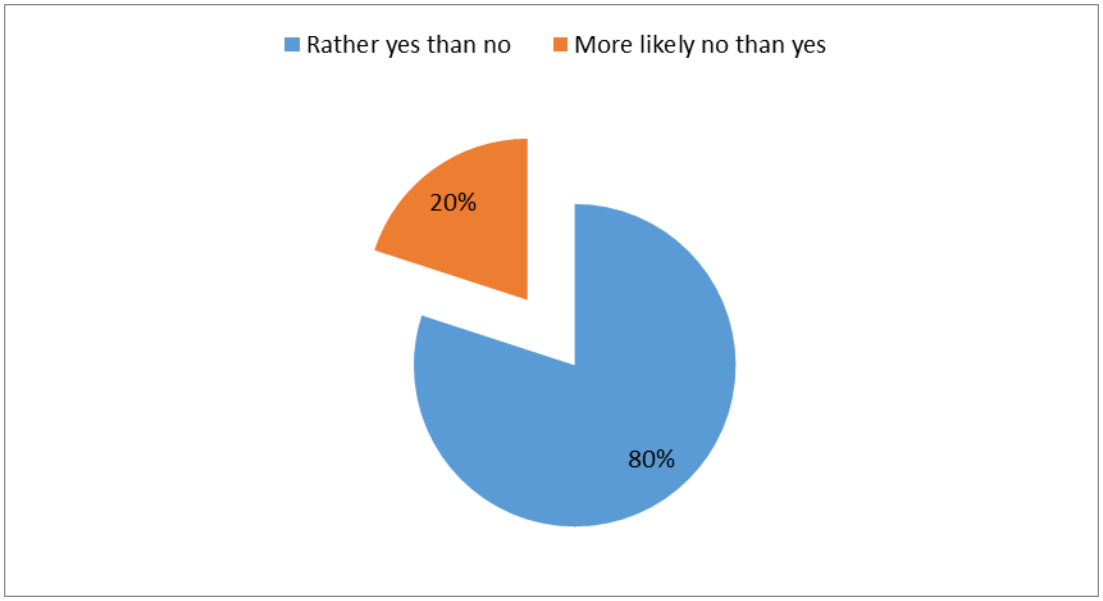

Figure 3 Survey of Future Welders "Has your understanding of the material improved after the introduction of improved recommendations for completing tasks?"

Students began to better understand the material, because the recommendations made the tasks more accessible to perception. The degree of autonomy, as further commented by teachers, has also increased. If earlier the teacher had to be constantly monitored, because students often sought additional explanations, now, as part of safety, the teacher can give students (for the most part) their own problems to solve.

V. CONCLUSION

In the course of work, we achieved our goal - we considered the issue of improving practical work in the course "Power sources for welding". The correct formulation of practical classes in this discipline helps the formation of a modern specialist-welder, expands his general theoretical outlook and gives him much-needed technical knowledge for his practical work. In the course of practical training, students acquire the skills of experimental work, the ability to handle instruments, independently draw conclusions from the obtained experimental data, and thus more deeply and fully assimilate theoretical material; students in the course of work more intelligently approach the development of new material. Thanks to the study, we found that the average score for the course "Power sources for welding" of students-future welders increased significantly after the practical training and recommendations developed by us into the activity of college No. 49 in Nizhny Novgorod.

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