

Results of Assessment of the Organization of Dual Education in the Training of Engineers and the Formation of Students Competences

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ABSTRACT

The article presents information on the clarification of the principles of successful implementation of dual education at the level of "Industry-Enterprise-University", the development of a new methodological support for dual education, the involvement of graduates in self-assessment in the formation of general competencies, and the results obtained. There are many features of the organization of the dual education system, and the most important of them, based on the analysis of their specific characteristics, a number of its principles, advantages, and a comparison of the characteristics of dual and traditional education systems, it was determined that eight categories of dual education are considered extremely important. The diagram of the results of the assessment of the organization of dual education by graduates of higher educational institutions (HEIs) showed that organizing dual education at the "Industry-enterprise-university" level is more difficult than organizing it at the "Enterprise-department (laboratory)" level. In the self-assessment of the level of development of ten competencies by HEIs graduates, not a single respondent chose the position of "competence is not developed", but respondents noted the weak development of certain competencies (from 10.4 to 42.2%). The results of the study showed that for the successful development of competencies within the framework of dual education, it is necessary not only to implement the principles of its organization, but also to improve teaching methods. The responses of the respondents showed that organizing dual education at the "Industry-enterprise-university" level is more difficult than at the "enterprise-department (laboratory)" level. It turned out that the content of professional module subjects is more closely related to the requirements of production enterprises. It is necessary to consider the basis of the study, and it is advisable to bring the laboratory equipment of the university to the level of modern production equipment. Reliance on the principles of dual education in organizing the implementation of dual education at the "industry-enterprise-higher education" level is its distinctive feature. Analysis of the practice of implementing dual education at the "industry-enterprise-higher education" level revealed the need to improve the regulatory and legal framework for its development.

Keywords: Dual education, "Industry-enterprise-higher education", Principles, Characteristics of educational systems, Dual education module, Competencies, Self-Assessment.

INTRODUCTION

In the context of the sustainable development of the world economy, training qualified engineering personnel in higher educational institutions is an ongoing pressing issue. On June 20, 2024, the President of the Republic of Uzbekistan held a videoconference meeting on the problems of "Priority tasks for the training of personnel in the engineering sector and further improvement of the activities of higher educational institutions", where he

highlighted the importance of innovation and engineering personnel in the republic today and identified the main tasks to be carried out, including:

- Based on the "Industry - Enterprise - University" chain, an industrial partner will be assigned to each university, and "Higher Engineering Schools" will be opened in 10 universities of the republic.
- Departments will be opened at partner enterprises of all engineering universities and dual education will be established, etc.

Also, in order to further develop the use of dual education in the Republic of Uzbekistan, the Regulation on the procedure for organizing dual education in the professional education system was approved by the Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 163 dated March 29, 2021 "On measures to organize dual education in the professional education system". In addition, the development of a national plan, a special program for the training of qualified engineering personnel in the field of renewable energy sources in the Republic of Uzbekistan, the creation of a new system for training engineering personnel using the dual education system in higher and secondary specialized educational institutions for this area are urgent issues [1,11].

The problems arising in the implementation of dual education were considered, and it became clear that the form of dual education is not always suitable for implementation and does not work everywhere [3,11]. However, to date, the methods of dual education and the methodological foundations and principles of its organization have been poorly studied, and insufficient research has been conducted in this area.

The possibilities of participation of future engineering personnel and employers in the implementation of dual education, their involvement in self-assessment in the formation of the development of competencies in the context of dual education have also not been sufficiently studied, and these issues are relevant.

In addition, in the context of dual education, students, taking into account the results of self-assessment, can consciously acquire knowledge and skills, and more successfully form personal and professional knowledge, reflecting skills, experience, and knowledge among students. This allows teachers to further improve their teaching methods, and they set themselves the task of developing excellent teaching software in the context of dual education, based on the experience and knowledge of students.

LITERATURE REVIEW

The dual education system is widely used in many countries such as Germany, China, the USA, Korea, Denmark, France, Macedonia, Montenegro, Switzerland, the Netherlands, Denmark, Austria, Serbia, Slovenia, Macedonia, Montenegro, Switzerland, the Netherlands, and some Asian countries, that is, in more than 60 countries, and it is one of the modern educational technologies and is considered the main system of education, in which the integration of the educational process and practice serves as the basis for the high-quality training of qualified specialists in various fields of production enterprises [5].

Speaking about the name "dual", dualism (lat. dualis - two-sided) is a doctrine that promotes the coexistence of incompatible states, principles, ways of thinking, worldview, aspirations, and epistemological principles. Dualism is one of the manifestations of pluralism. The term dualism was introduced by the German philosopher H. Wolf (1679-1754). Dualism represents the following pair of concepts: the world of ideas and the real world. Dualism can manifest itself in philosophical, religious, anthropological, and ethical forms[2]. L.V. Sidakova recognizes that the dual education system is "an educational system that involves the combination of the educational activities of an educational institution with the activities of production enterprises" [3]. The dual education system of specialist training can be viewed as "a system of education that is coordinated between higher vocational education and employer production enterprises, aimed at training specialists with the required level of qualification in a particular profession" [4]. Also, with a deeper analysis of domestic and foreign literature, the dual education system can be imagined as an educational model in which theoretical training can be carried out in educational institutions, and practice in production enterprises [5]. An analysis of scientific and pedagogical literature shows that it is possible to answer several questions that have arisen regarding the organization of dual education at present, and the technical meaning of such concepts as "dual education", "dual education program", and "dual training" has been clarified[10-11].

RESEARCH METHODOLOGY

A number of problems are encountered in the process of introducing the dual education system into the educational system of higher educational institutions. The main difficulties in training personnel are the insufficient level of training readiness of the enterprise, namely the lack of training places at the enterprises; the need for a mandatory increase in the price of the manufactured product, the lack of funds for training in order to attract

students to training; the formation of the content and methods of newly created dual education programs in cooperation; the formation of the principles and categories of dual education, the lack of equipment, the lack of funding, and the lack of many activities within the framework of dual education, etc.

One of the most important problems in the training of engineering personnel in higher education institutions (HEIs) is the lack of a coherent and consistent theoretical and practical training of students in higher education institutions and their inability to master it simultaneously due to changes in it, the existence of a gap between employers and the labor market, and the application of a dual education module to the higher education system is effective in eliminating this problem (Figure 1).

In recent years, measures have been taken in the Republic of Uzbekistan to further improve the higher education system by introducing state educational standards and professional standards adapted to the future job functions of higher education graduates, aimed at gradually reducing this gap. The implementation of such a model of education in the training of future specialists of any profession can be implemented using a dual education system [5-11].

For the successful implementation of dual education in the higher education system, it is proposed to develop a dual education model based on cooperation between participants in the educational process [5].

The main elements of this model are:

- legal components;
- conceptual components;
- a program for the introduction of dual education for higher education institutions;
- a personnel component.

Each of the proposed elements mutually recognizes the other. In this case, the conceptual component is represented by the technological, methodological, personal-result levels, mechanisms and a number of conditions for the student's motivation for learning.

As is known, when building a dual education system at several structural levels, such as "Enterprise - university", "Enterprise - department", "Enterprise - laboratory", "Network - enterprise - university", a number of problems related to dual education arise. In this case, the necessary one is selected depending on the goal set.

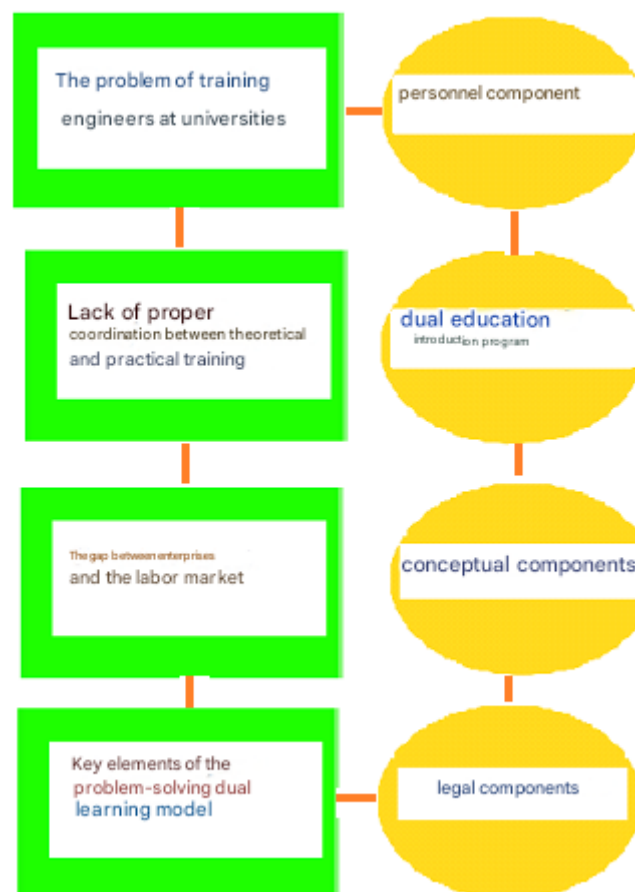


Figure 1. Using the dual education model to solve problems in higher education institutions.

There are many features of the organization of the dual education system, the most important of which, based on the analysis of its specific features, are a number of its principles, advantages, and a comparison of the characteristics of the dual and traditional education systems in organizing dual education at the level of "Industry - Enterprise - University". According to the results of the analysis, eight (8) categories of dual education are considered extremely important:

1. The structure, content and scope of specialist training correspond to the real needs of the enterprise.
2. Practice is carried out directly on modern equipment of production enterprises.
3. The topics of laboratory, course work and graduation qualification work are oriented to the potential needs of employer enterprises.
4. The presence of modern analogues of production equipment (real models, samples) in each auditorium of the enterprise.
5. Students get acquainted with the corporate culture of the enterprise and work as a team.
6. The state is responsible for the theoretical part of education, the enterprise is responsible for the practical part, or both are jointly responsible.
7. Practical work is carried out under the guidance of a teacher from the enterprise.
8. Teachers have the opportunity to improve their skills in special subjects at the enterprise.

A comparative analysis of the differences between dual and traditional education systems shows that the above points were selected for the organization and implementation of dual education at the "Industry-Enterprise-Higher Education" level.

At present, the methodological foundations and methodological principles of organizing dual education have not been fully studied. Also, the possibilities of students' participation in the implementation of dual education programs, their involvement in self-assessment in the formation of their competences in the dual education environment have not been sufficiently studied. In addition, in the dual education environment, it will be possible to monitor the more successful formation of personal and professional knowledge, reflecting the conscious acquisition of their knowledge, experience and skills, taking into account the results of self-assessment. Based on the self-monitoring of students' experience and knowledge, teachers should develop excellent software for teaching in the dual education environment, which will allow improving the methods of teaching students.

The purpose of the study is to clarify the principles of successful implementation of dual education at the "Industry-Enterprise-University" level, develop methodological support for dual education, and involve graduates in self-assessment in the formation of general competencies.

Research methods: analysis of scientific and pedagogical literature in the field of dual education; mutual evaluation of the content of the higher education program; research; survey, comparison, analysis.

Approbation of dual education: Approbation of the organization of dual education at the "Industry-Enterprise-Higher Education" level was carried out at the Karshi Engineering and Economics Institute in the Republic of Uzbekistan within the framework of the implementation of dual education in the specialty 607111000-Alternative Energy Sources.

Analysis and results. It is shown that such methodological categories of modern education as "objects", "types", "elements", "conditions for carrying out professional activities" can allow the formation of methodological principles for the organization of dual education at the "Industry-Enterprise-Higher Education" level.

As is known, in the context of dual education, students should be prepared for practical training, develop skills in working with objects, and gain experience in professionally important types and elements of their activities in practical training.

The diagram of the results of the assessment of the organization of dual education by university graduates showed that organizing dual education at the level of "Industry-enterprise-university" is more difficult than building it at the level of "Enterprise-department (laboratory)". In the self-assessment of the level of development of ten competencies by university graduates, not a single respondent chose the position of "competence is not developed", but respondents noted the weak development of certain competencies (from 10.4 to 42.2%). The results of the study showed that for the successful development of competencies within dual education, it is necessary not only to implement the principles of its organization, but also to improve teaching methods.

As a result of the analysis of the current practice of introducing dual education, it was found that for this, first of all, it is necessary to further improve the existing regulatory and legal framework, and to ensure the creation of conditions for the development of dual education in all areas of education.

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The organization of dual education in higher education institutions is carried out based on its principles. According to the results of a comparison of dual and traditional teaching methods, the following basic principles of organizing training on the basis of dual education at the “Industry-Enterprise-University” level were identified:

1. The structure, content and volume of specialist training should correspond to the real needs of the conditions of the enterprise.
2. The topics of laboratory, coursework and final qualification graduation works should be oriented to the potential needs of employer enterprises.
3. The practice should be equipped with modern equipment of the production enterprise, etc.
4. When organizing dual education at a higher education institution and a manufacturing enterprise, the higher education institution should be responsible for the theoretical part of the education, and the manufacturing enterprise should be responsible for the practical part, and they should jointly monitor the formation of the qualifications of future engineers.

Based on the above, the following specific methodological principles for organizing dual education at the “Industry-Enterprise-Higher Education” level have been developed:

1. Higher education institutions and manufacturing enterprises should work together in developing new dual education programs for training engineering specialists.
2. Types, elements, and implementation conditions for training engineers at higher education institutions should correspond to the topics that reflect the professional competencies of enterprises.
3. Objects, types, elements, and implementation conditions for the formation of competencies reflected in the professional activities of enterprises should be revealed through new dual education programs in the content of the subjects of the department.
4. In the context of dual education, it is necessary to conduct practical training for students at universities and enterprises, ensure the formation of skills in working with the necessary objects, and form experience in carrying out engineering professional activities.
5. The employer, as a teacher, should involve teachers of industrial enterprises in teaching individual sections of specialized disciplines, and, if necessary, conduct additional training seminars for them.

It was found that the rational organization of dual education at the “Industry-Enterprise-Higher Education” level, the diversity of the proposed methodological principles, the educational and methodological complexes of the disciplines allow solving the problems of coordinating and developing the educational and cognitive activities of students (theoretical and practical classes), the formation of dual education in them.

In this regard, the results of the survey and questionnaire conducted among graduates of the “Alternative Energy Sources” educational program show that the survey of students who graduated in 2023 was conducted in the fall of 2024. The results of the new survey showed that 18 out of 21 graduates responded to the requirement for the effectiveness of dual education. The results of the experiment show that they learned the knowledge needed in production enterprises at higher educational institutions, since they received engineering professional knowledge in accordance with the requirements of production enterprises on the basis of dual education. Due to the above-mentioned difficulties in implementing the principles of organizing dual education, 100% results were not achieved. The results of the study of existing problems are reflected in two diagrams:

The first diagram shows the organization of dual training in all disciplines of the department based on programs within the framework of the professional module at the level of “Industry-enterprise-higher education” and the assessment of graduates (Figure 2).

The second diagram shows the organization of dual training at the level of professional laboratories of enterprises and higher educational institutions, and the extent to which students mastered the subjects of the educational direction “Alternative Energy Sources” (Figure 3).

Graduate students were asked to evaluate and rate their positions in the organization of dual education corresponding to points 1, 2, 3, and 5 of the 8 criteria listed above using four different assessments (“not implemented”, “poorly implemented”, “highly implemented”, “100% implemented”) and “100% implemented”. It should be noted that none of the respondents chose the “not implemented” position, and there were no “poorly implemented” answers in their answers.

The respondents' answers showed that building dual education at the “Industry-Enterprise-University” level is more difficult than at the “Enterprise-Department (Laboratory)” level.

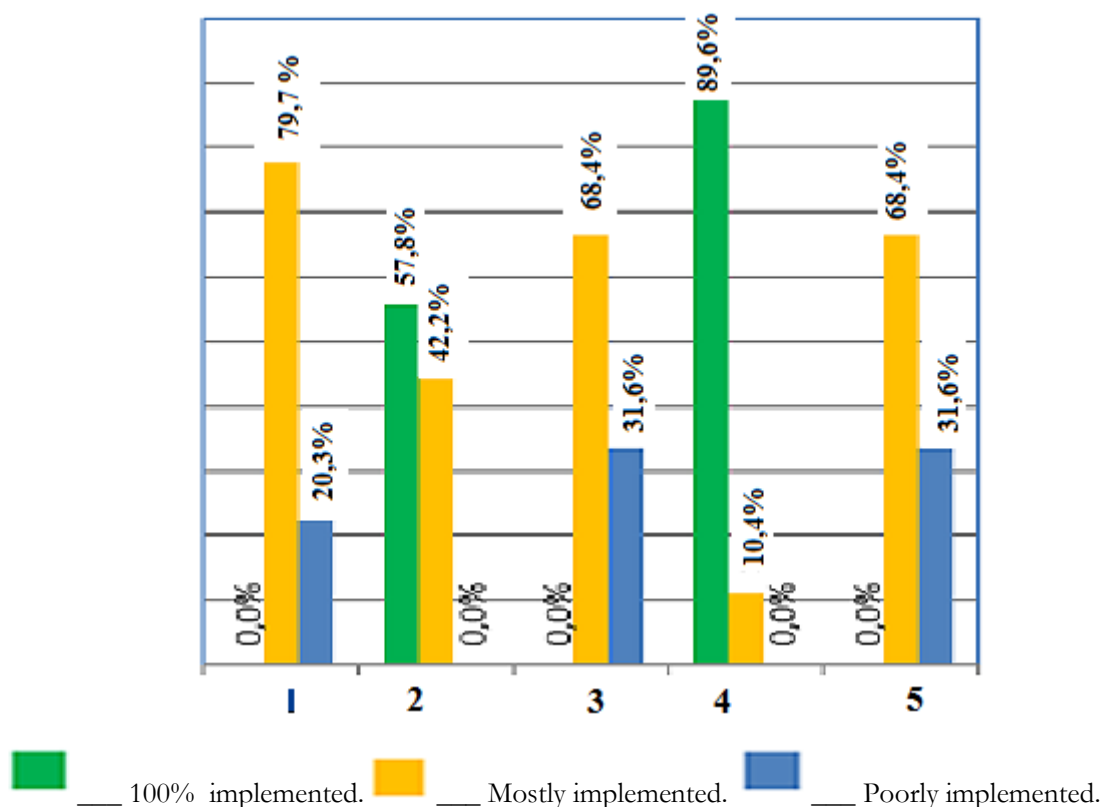


Figure 2. Assessment of the organization of dual training at the level of “industry - enterprise - university” by graduates. 1- Dual training contributed to professional development during the training period. 2- Graduates got acquainted with the corporate culture during training. 3- Practical training was carried out directly on modern production equipment. 4- Graduation qualification projects were focused on the prospective needs of employers. 5- Content and scope of professionally oriented courses corresponded to the enterprise needs.

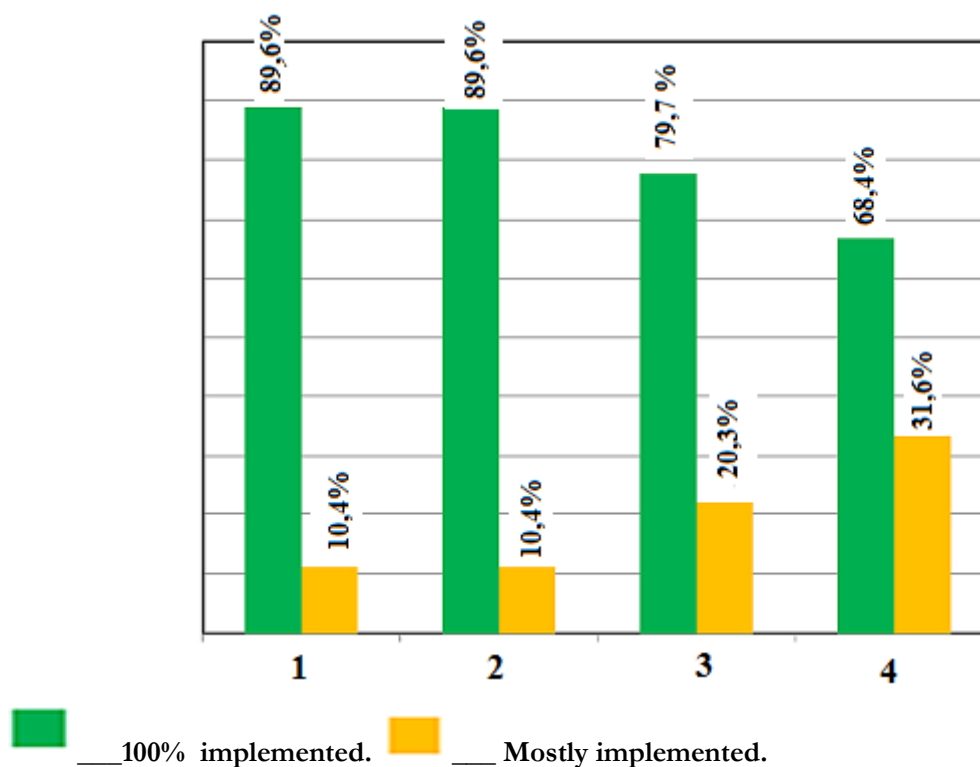


Figure 3. Assessment by graduates of the organization of dual training at the “enterprise – department (laboratory)” level. 1- Dual training implemented at the “enterprise – department (laboratory)” level has contributed to professional development. 2- Dual training at the “enterprise – department (laboratory)” level provided for the familiarization with corporate culture. 3-

Practical training was carried out directly on modern production equipment. 4-Content and scope of professionally oriented courses corresponded to the “enterprise – department (laboratory)” needs.

It turned out that the content of the professional module subjects requires consideration based on the requirements of production enterprises, and it is advisable to bring the laboratory equipment of the university to the level of modern production equipment.

The results of the self-assessment of the level of competence formation of students graduating from the “Alternative Energy Sources” educational direction were considered. Graduates were offered a list for conducting a self-assessment of the level of formation of their competences, which is presented in the diagram in Figure 3. The assessment was carried out using the following scale: 0 - competence is not developed, 1 - weakly developed, 2 - practically developed, but not fully developed, 3 - fully developed. The results of the study are presented in Figure 3. The results of the study are presented in Figure 4.

Analysis of the results of the self-assessment shows that not a single person chose the position of “competence is not developed”. At this time, respondents chose the position “competence is poorly developed” in relation to one, maximum two competencies. According to the results of the survey, the lowest result was obtained for the position “Ability to communicate in Russian” (Fig. 4). The results obtained showed that in order to successfully form competencies in future engineers, it is necessary not only to implement the principles of dual education, but also to improve the methodology of dual education.

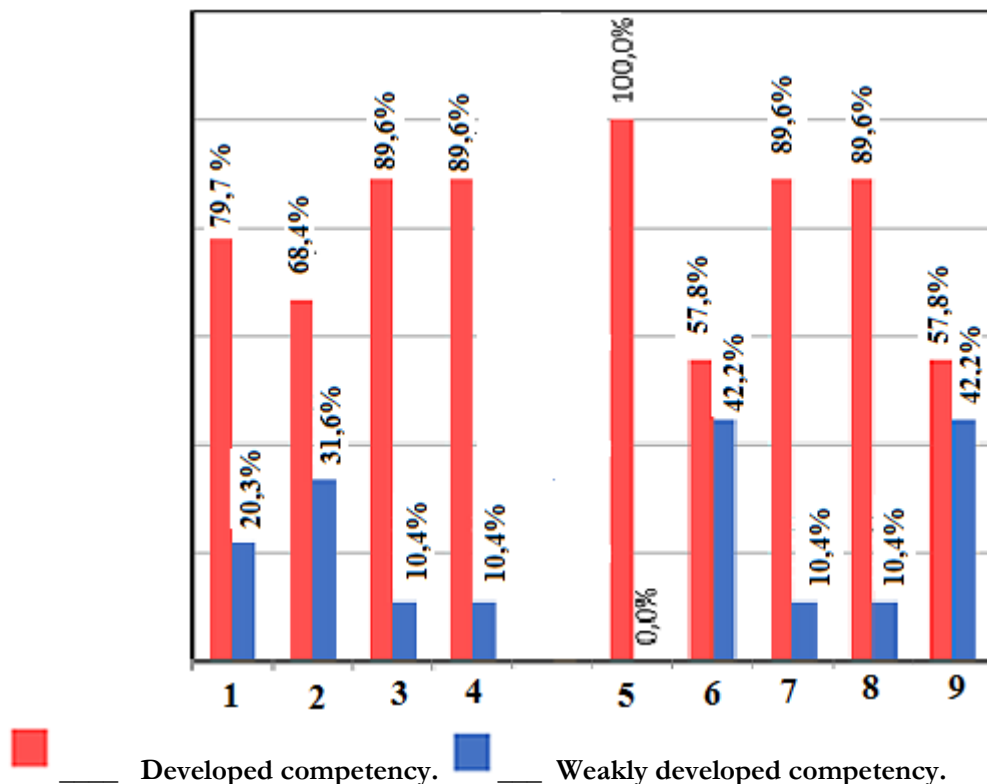


Figure 4. Self-assessment by graduates of the level of competency development. 1-Self-education ability. 2-Self-organization ability. 3-Strive for creative self-organization. 4-Readiness for professional growth. 5-Ability to communicate in Russian. 6-Ability to collaborate with colleagues, ability to work in a team. 7-Ability to independently solve problems related to professional activities. 8-Readiness to show responsibility. 9-Capability of systemic thinking.

CONCLUSION

1. In organizing the implementation of dual education at the “industry-enterprise-higher education” level, reliance on the principles of dual education is its distinctive feature. Analysis of the practice of implementing dual education at the “industry-enterprise-higher education” level revealed the need to improve the regulatory and legal framework for its development.

2. The methodological principles of organizing dual education at the “industry-enterprise-higher education” level allow for a more successful formation of a joint educational platform between higher education institutions and enterprises. The development of new dual education curricula in cooperation between higher education

institutions and enterprises and the rational organization of the educational process are of great importance in conducting theoretical and practical training of students.

3. The results of a special survey among graduates of the “Alternative Energy Sources” educational direction revealed that the skills acquired within the framework of dual education and the materials studied meet the requirements of manufacturing enterprises.

4. According to the questionnaire survey conducted among students, it turned out that the successful organization of dual education “Industry-enterprise-high school” is more difficult to build a dual process than at the “Enterprise-department (laboratory)” level. It was also identified the need to revise the composition of the subjects taught and the content of the materials in them, taking into account the needs of the enterprise.

5. It was found that involving students and graduates in the evaluation of the dual education system, and the self-assessment procedure in further developing the formation of their competencies will help improve dual education.

6. For the development of the successful formation of competencies, it is important to implement the principles of organizing dual education, and it is necessary to continue conducting scientific research on further improving the methods of training students on the basis of dual education.

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