

CONSTRUCTION OF DUAL SYSTEM OF PREPARATION OF ENGINEERING-PEDAGOGICAL PERSONNEL AT HIGHER EDUCATION INSTITUTE

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Abstract: *Purpose of research project: Definition and theoretical justification of didactic conditions for the design of the dual system of education, which are focused on training specialists with high level of general culture and professional competence; bringing the human resources potential of specialists to the world level. Novelty of the research is as follows: Theoretical justification of possibilities of using the dual system of education and restructuring of the education system, which includes the systematic transformation of its content, resources, forms and methods for human development. Practical significance of the research project is that the main provisions of the research can be used in development of educational programs and in organization of educational processes in the university. The new system of education uses a problem-based interactive method of education as the main one. A new system is creative and aims to give not only knowledge, but also the ability to use them. That is why here practical work becomes the leading beginning of education.*

Keywords: student, information and communication technologies, research, dual training, competence, engineering and pedagogical education.

The dual system of professional education received worldwide recognition, it is the most widespread and recognized form of training of personnel, which combines theoretical training in educational institution and industrial training at production enterprise. Dual training is a kind of training in which the theoretical part of the training is conducted on the basis of educational organization and practical-in the workplace, i.e. combination of both theoretical and practical training in the educational process. Students master their chosen profession directly in the workplace simultaneously with the study, i.e. they study across in two places: the first two days a week at institute, the rest of the time - at enterprise.

According to A. N. Bleyer,¹ the activity of entire system of additional professional education should be directed to achieve the following main objectives:

- Saturation of the labor market by specialists with high level of general culture and professional competence;
- Provision of social protection, social rehabilitation and employment of specialists, elimination of all forms of their functional non-literacy;
- Bringing human resources to the world level;
- Increase of cumulative intellectual and spiritual potential of society together with other levels of professional education, development of the creative abilities of person.

The dual system of engineering and pedagogical education, built on the basis of coordinated interaction between the two spheres - production and education, provides optimal conditions for mutual transformation of engineering and pedagogical activity.

Materials and methods

Methods of the research. In the course of the study the following research methods were used: theoretical (study of teaching methods in the system of modern professional training and transfer of the content itself and modeling of scientific research); empirical (analysis of the content of professional training); statistical (author's and student's questionnaires); interview, practical lessons for implementation of the dual training system, analysis and conclusions of the study.

Experimental research base. The students of faculty "Pedagogy - psychology" of Kazakh National Pedagogical University named after Abay.

Stages of the research. *Preliminary stage.* The literature about the research problem was studied, as well as the state of psychological and pedagogical support of processes of the dual system of education in higher educational institutions of the republic. The development of didactic facilities for conducting the experiment and their initial approbation at the university were carried out. Also, there was modeling the system of implementing the productive activity of students on the basis of designing dual system of training. ***The main stage.*** There was substantiation of theoretical concept of the research, correction of experimental work based on analysis of primary experiment results;

¹ A. N. Bleyer, *Psychology of activity in extreme conditions*, Moscow, Academiya, 2010.

specification of research tasks and running of basic pedagogical experiment on studying of effectiveness of didactically substantiated system of student productive activity. **The final stage.** Processing of pedagogical experiment data was carried out on the basis of analysis of its results; the revealed results are compared with initial positions and a hypothesis of the study; general conclusions are drawn.

Results

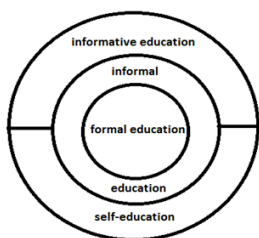
Structure and content of the model. During development theoretical grounds for constructing the dual system of engineering and pedagogical education at university we proceeded from fact that they must ensure *adequacy of*:

- educational goals for social and production needs;
- organizational approaches for socio-philosophical and worldview foundations of educational activity;
- didactic bases for methodological specificity of engineering and pedagogical education.

There are many points of view on the most probable or optimal structure of the continuous professional education system. Many variants of regional and branch systems have appeared, all the variety of which can be reduced to three types:

- organizational and functional structure of continuous professional education;
- systemic continuous professional content;
- man is a self-developing system.

There are scientists B. S. Gershunskiy, V. G. Osipov, V. G. Onushkin² and others, who stay on the position of organizational and functional structure of the continuous professional education.



It is possible to present several models of the continuous education on the basis of available theoretical developments. For example, V. G. Osipov³ offers the following structure of continuous education (figure 1).

Figure 1: The structure of the continuous education (according to V. G. Osipov)⁴

² B. S. Gershunskiy, *Philosophy of education for XXI century*, Moscow, Sovershenstvo, 2012; V. G. Osipov, *Sociology: The foundations of General theory*, Moscow, Norma, 2008; V. G. Onushkin, *The theoretical basis of lifelong education*, Moscow, Pedagogika, 1987.

³ V. G. Osipov, *Sociology: The foundations of General theory*, 2008

⁴ *Ibidem*.

In author's opinion, if we represent the structure of entire system of the continuous education in the form of concentric circles, then formal education should be placed in the center; the next circle immediately outside it will be informal education; finally, the most external, vast circle, divided in half, is informative education and self-education. The most important element in this model is formal education. It is basic, original. This is the education that person receives before starting professional activity.

B.S. Gershunskiy⁵ offers another model of continuous education: pre-school education; general secondary education (school, technical professional school, technical high school); higher educational institutes; professional education (postgraduate study); personnel development (continuous self-education, socio-political education, increasing of general cultural level, activities by interests); personnel retraining (uniform system of professional guidance and selection); uniform national economic complex.

Model of learning is becoming an independent goal of professional education. As stressed by A. Shelten,⁶ formal, non-professional and social abilities can only be revealed if theoretical and practical training involve the use of open and complex educational situations. In these situations it is necessary to develop abstract thinking on the basis of proposed algorithm of actions in professional activity. Training in this case should occur in small working groups.

Traditional lessons are based on oral presentation of educational material; the basis of traditional production training is the system of "three steps": *demonstration - reproduction - training*.

To master key qualifications it is necessary to enrich professional training with such situations, in which trainees can independently organize educational process during solving complex problems. The teacher in this case plays the role of a consultant in the educational process. Methods of guiding text and project are recognized as the most suitable to develop the key qualifications in the production training. Action-oriented training methods are expedient in professional training in the first place. There are role-playing games, oriented to application of experimental training by situational method, and method of projects. Among the methods that facilitate the transfer of key qualifications in professional school there are also implementation of inter subject communications, method of strategic learning, method of development

⁵ B. S. Gershunskiy, *Philosophy of education for XXI century*.

⁶ A. Shelten, *Introduction to professional pedagogy*, Ekaterinburg, URFU, 2005.

systematic thinking in learning, problem-developing and constructive methods.

Realization of inter subject communications assumes thematic combination of subjects within one integrated lesson. As a result, a complete picture of studied concepts and phenomena arises in consciousness of trainees. As practical research of German scientists shows, training, which focused on application of experimental training by situational method, is especially effective from the point of transfer of key qualifications at professional school. The situation of the experiment assumes close connection between gained knowledge and their practical application, also complex formulation of tasks borrowed from working practice.

Such training occupies intermediate position between theory of specialty and practice in the specialty, also developstechnical and practical skills.Connection between acquired knowledge of theory of specialty and their practical application in the specialty is established in complex situation. This method allows to form such key qualifications as ability of independent thinking, analytical thinking, ability to transfer of knowledge from one field to another. Students are offered situations that require ability to learn and work in group (social abilities), as a result of that, individual abilities of each student develop (accuracy, reliability, striving for quality in work, consciousness, etc.).

Developing labor-market dictates new requirements to professional education of modern specialists. Professionally significant qualities in new conditions are independence in judgments and actions, level of development of reflexive abilities, moral qualities, primarily responsibility, sense of duty, etc.

Thus, in this aspect of conceptual importance for construction of the dual system of engineering-pedagogical education in the University has a provision, that the continuous engineering-pedagogical education allows to combine humanitarian principles with needs of production sector and society.

Stages of Model Implementation. A practical lessons are shown in the following scheme (figure 2).

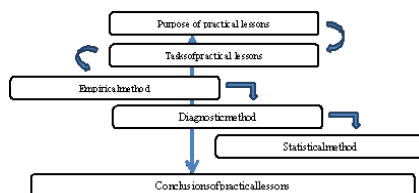


Figure 2: A practical lessons are shown in the following scheme

In general, continuous education is considered by these authors as an integral system, which has a certain structure. Integrity is given to it by integrative properties, for example, continuity of all links in education.

The ascertaining stage. Any model of continuous education and its analysis are incomplete if they don't include comparison to traditional education system. If continuous education is really a new paradigm, as many experts insist on, then in this case it is necessary to find out, first of all, what characteristics and in what parameters it differs from previous one and what principles of transition there are from one to another; whether continuous education is simple destruction of the traditional education system or represents her dialectic denial and contains a lot of things that has undergone the most strict and true testing through the time.

In our opinion, the continuous education really represents an essential new paradigm in the development of education, which marks fairly radical departure from old, previous educational paradigm usually named as traditional. In other words, there is a reconsideration of the concept of education itself: its purposes, entity, functions, principles, organization.

So, according to V. P. Zinchenko,⁷ the continuous education is a new method of educational activities, the target orientation of which are integral development process of personality, translational enrichment of his creative potential, constant growth of his forces and abilities.

Table 1 below presents comparative characteristic of principles of functioning and development of education in traditional and continuous paradigm, which demonstrates that the continuous education system dialectically denies the principles of the former traditionally developed discrete education system.

Table 1: Principles of functioning and development of education in traditional and continuous paradigm

Characteristics of principles of education functioning and its development	Traditional system of education	Continuous system of education
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⁷ V. P. Zinchenko, *The science of thinking: Developing training*, Moscow, APK PPK, 2002.

Interrelation with material production	Set by production, isolated from it	Determines the growth rate, the nature of its development, integrates with it
Interrelation with social structure of society	Sets social distinctions	Promotes overcoming social distinctions
Target orientation	Prepares a person to perform certain functions in existing conditions	Prepares a person for universal activity in constantly changing social conditions
Content of education	Assimilates a certain amount of knowledge for future use	Promotes assimilation of knowledge for the purpose of concrete practical application
Way of teaching	Book-verbal	Problem-practical
Organization of training	Individual-collective	Collective-individual
State of forms and methods of learning content	Stable	Dynamic
Functioning of system	Isolation of functioning of pre-school, school and post-school links; autonomy of general, professional and special education	Integration, continuity of all links and forms of education

Unlike the traditional way of education which is limited by material production, the new way, on the contrary, determines rates of its development, provides continuity of education in certain kinds of activity in close connection with practical activities itself. The continuous education system in addition to developing abilities of each person also promotes overcoming social differences between people. This system is aimed at preparation for universal activity. It raises personal abilities to adapt to quickly changing world. The new paradigm brings the principle of dynamism, flexibility of content, forms and methods of teaching to the first place. The continuous education provides continuity of all structural elements of the system, complementarity of various forms and types of teaching.

Discussion

Reorganization of an education system includes systematic transformation of his contents, means, forms and methods for

development of the person. It is not the single act of change of one way of education by another, it is the continuous process of reasonable basic changes of system.

Number of scientists⁸ is asked about a role of the personality in an education system. As the main thing mark out activity of the personality in the teaching, cognitive activity, the system of the relations with other people, need to teach to study, to cultivate interest in knowledge at each person. According to these authors, the function of teacher also changes: he acts as the organizer of the developing environment, the converter of cognitive activity of students who become a kernel of educational process.

In other words, a person should be placed at the center of any educational system: not the student for an education system, an education system for the student. It means that a humanization, individualization, differentiation, democratization, integration have to be the fundamental principles of a system.

A number of scientists⁹ are attached the great importance to non-standard education, self-education, considering these directions of one of the most effective and perspective forms of adults education, since the interests of listeners are at the center of their attention.

Without excluding the constructive that inherent in the traditional system of professional education, which is focused on training of the expert, it should be noted that in the conditions of tough regulation of content, the professional education possibilities of formation of the self-sufficient personality capable to adoption of crucial independent decisions were minimized. At the same time emerging market of work dictates the new requirements to modern experts' professional training. As professionally significant qualities in new conditions denote the independence in judgments and actions, the level of reflexive abilities development, moral qualities, first of all responsibility, call of duty, etc.

⁸ K. Y. Vazina, *Continuous professional self-development*, Moscow Novgorod, 2012; E. F. Zeer, *Psychology of professional development*, Moscow, Academiya, 2006; V. I. Liaudis, „A new paradigm of educational psychology and the practice of education”, in *Psychology*, 4, (1998), pp. 88-97; A. Y. Nayn, *Training the personnel in market conditions*, Chelyabinsk, Transport, 1991.

⁹ A. V. Darinsky, *Educational institutions of old St. Petersburg*, Saint-Petersburg, Glagol, 2002; T. N. Levashova, „Principles for the management of ontologies used in the integration environment knowledge”, in *SPIIRAS Proceedings*, 1, (2002), pp. 51-68; G. I. Marchuk, *The horizons of scientific research*, Moscow, Sovetskaya Rossiya, 1986; V. G. Onushkin, *The theoretical basis of lifelong education*, Moscow, Pedagogika, 1987; F. I. Peregudov, *Introduction to system analysis*, Moscow, High school, 1989.

According to fundamental direction chosen in the research, there is a tendency to develop a continuous educational system, in which the development of the humanitarian principles the interest of reforming the society also takes into account and update on the basis of new professionals market mechanisms production, who independently making responsible decisions and implementing them in practical activities, able to assert themselves in a changing society.

Thus, in this aspect of conceptual importance for the construction of the dual system of engineering-pedagogical education in the University has a thesis that the continuous engineering-pedagogical education allows you to optimally combine humanitarian principles with the needs of the production sector and society.

Identifying the fundamental, conceptual and meaningful ideas which meet requirements above was carried out in line with the trends of internal, phenomenological and methodological, as well as "external" socio-educational nature which have a decisive influence on the development of engineering-pedagogical education as a specific integrative branch of vocational education.

The first area of research searches was connected with the study, analysis and summary of the entire diverse spectrum of scientific - theoretical and praxeological aspects of formation of continuous education system in our country. In this regard, it should be noted that in domestic pedagogy, an intensive research of the problems of education of individual scientists is continuing. The situation is more successful with the study of the individual links functioning in the continuing education emerging system, and with the development of practical recommendations.

The second area of theoretical research associated with the identification of socio-philosophical bases, ideological foundations of educational activity, which must determine approaches to engineering-pedagogical education in higher education institution, lay in the context of understanding the tendencies of changing the engineering profession modern world "ideology".

The analysis of scientific sources on this issue¹⁰ showed that multi-scale transformation that characterizes the development of national

¹⁰ M. Vrazhnova, „Integrated training of specialists in conditions of University-production”, in *Integration of education*, 1, (2003), pp. 61-66; O. V. Dolzhenko, V. L. Shatunovskii, *Modern methods and technology of teaching in technical University*, Moscow, Vysshaya Shkola, 1991; V. P. Zinchenko, *The science of thinking: Developing training*, V. S. Mikhalkin, „The concept of the integrity of the natural science cycle of disciplines of a technical college”, in *Integration of education*, 1, (2003), pp. 1-3.

education at the turn of XX-XXI centuries, also touched an engineering education. And from this point of view the most noticeable change, of course, is the transformation of majority leading polytechnics and technical institutions into technical universities, which gave a powerful impetus to the process of transition from the sectoral system of training of engineers to the University, the distinctive feature of which is the fundamental nature of education.

The third area of research was focused on the identification of didactic bases of the dual system, adequate methodological specificity of engineering-pedagogical education. As shown above, the specificity of dual vocational education system is variability of teaching methods and conditions of training in systems-components while maintaining a uniform methodological basis.

In the process of engineering-pedagogical education:

- the engineering profession is mastered not just at the level of acquaintance with its basics, but at the level of readiness for professional activity in this specialty;
- psycho-pedagogical training permeates the engineering component of the training as a methodological frame, providing a new, humanistic and humanitarian-oriented quality.

Accordingly, a third conceptually significant idea, which providing the adequacy of the didactic basis for constructing a dual system of engineering and pedagogical education in the university with its methodological specificity, can be formulated as follows: the dual transformation of the system in the process of professional training of engineering and pedagogical staff: integration of engineering and pedagogical education as a manifestation of its systemic integrity.

New nature of engineering thinking that require a higher professional engineer culture, highly developed reflection on its own activities, use representations and methods of modern methodology and applied humanities at work.

In modern civilization, technical culture, of course, is the most popular, leading (it is literally changing the face of our planet), humanitarian culture – partly in opposition. Humanitarian oriented person refuses to accept scientific and engineering conditionality and causality, of course, not generally, not totally, but in relation to the life of man himself, society or nature. He is convinced that both man and nature– the essence of spiritual education, which cannot be treated with standards of technical culture. For him it is all live actors, it is important to understand, to hear, to speak (hence the role of language) but it cannot be manipulated, they cannot be turned into money.

To overcome the above confrontation of the two cultures, as we know, are called *humanization and humanitarization* of technical education. This idea today is one of the universally recognized principles of domestic vocational education. However, the proposed approaches for its implementation in educational practice are quite different. Nevertheless, it is possible to distinguish two main positions.

One position is that in technical universities need to teach philosophy, sociology, theory and history of culture, psychology and other disciplines of the Humanities cycle. Another position is not as clearly as the first one, is to affirm that the humanities education is not so much the study of humanitarian disciplines as a special approach to reality, a special way of thinking, a special worldview. Often by arguing of the second approach, referring to the American experience, where future scientists and engineers listen to the corresponding Humanities courses or study any Humanities subject, like "the characteristics of a medieval Japanese poetry" or "Russian literature of XIX century".

In this formulation of the question to speak about the humanization of technical education is possible only in the sense that since the separation of technical and humanitarian cultures is becoming intolerable, deepening the crisis of our civilization, we need to strive for the formation of an integral humanitarian and technical personality. In other words, the ideal becomes a holistic person, versed in both cultures.

You can specify other pedagogical problems that require his scientific and practical, didactic, methodical decisions. What and how to teach future technicians and engineers? Does it make sense to continue educational programs created in the past years, or they need to replace with new ones? What are the goals and ideal of the education of a modern technician and engineer? To what extent, for example, is he responsible for the consequences of his activities? In this regard, is it necessary for a future engineer to teach engineering ethics, as in a number of Western countries?

The question of responsibility in engineering today has a special significance. Individual critical articles appearing in print, have served decorative purposes, were intended to demonstrate the concern of the parties, or to release part of steam. There were many first and second "calls": death and disease of people from nuclear and chemical production and waste, pollution of environment, destruction of soil in the tundra, the drying of the Aral sea, the disappearance of many small rivers and marshes, major accidents at various closed and open industries and factories, etc. However, only Chernobyl was forced to really think about the problem of responsibility of all, starting from the state and

ending with engineer and designer. This raises a serious problem of how to reverse these negative and largely a dangerous trend.

At the same time, it seems that the mere inclusion of philosophy and the history of technology or engineering ethics in a number of disciplines of the curriculum of training of engineers will not solve this problem. The resolution of this contradiction is seen in the replacement of the old, technocratic attitudes, which largely continues to support engineering education, a new integrative humanistic-technological approach appropriate complex change of all didactic tools used in the educational process.

It should talk about the formation on the basis of a new "ideology" of the engineering profession the professional culture of engineers, future engineers (University students), and already working engineers. Society and the industrial sector are also interested in this. This should be aimed at the sphere of engineering and technical education. And the willingness of the latter to realize new worldview, social and philosophical attitudes is largely determined by the level of psychological and pedagogical training of teachers of the higher technical school, i.e. quality of engineering and pedagogical education.

Thus, a new humanistic technology "ideology" of the engineering profession becomes a "web" of interaction between industrial and educational spheres in the aspect of professional training of specialists of engineering profile, including and even primarily engineering and pedagogical education.

This allows us to formulate the second defining conceptual position, in accordance with which: uniform "ideology" of replacing the technocratic approach with a new humanistic-technological approach acts as a system-forming factor of interaction of educational and production spheres in the process of engineering and pedagogical education.

Dedicated fundamental and conceptually significant ideas provide the methodological unity of valuable objective (axiological), substantively organizational (ontological) and technological bases for constructing the dual system of engineering and pedagogical education, and therefore they were used as the basis for its theoretical, methodological, conceptual modeling.

The experience of using the dual education system showed the following advantages of the system in comparison with the traditional:

- The dual system of training specialists eliminates the main drawback of traditional forms and methods of teaching - the gap between theory and practice;

-Influence on personality of specialist is included in the mechanism of the dual education system, which contributes to creating new psychology of the future specialist;

-The dual training system of employees creates high motivation for obtaining knowledge and skills in work, because the quality of their knowledge is directly related to performance of official duties in the workplace;

-Interest of heads of relevant institutions in practical training of their employees;

-Educational institution takes into account requirements for future specialists in the course of training during close contact with the customer.

Dual education system can be widely used in professional training in Kazakhstan in coming years.