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## FORMATION OF CONTINUOUS AND MULTILEVEL TECHNICAL EDUCATION

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**Abstract:** *In article are considered the theory and model of construction of educational process of preparation of the engineers, different from the traditional scheme by parallel – consecutive studying of fundamental and special disciplines, and also necessary conditions of formation of educational process with principle application the interdisciplinary and multidiscipline's are considered.*

**Keywords:** *inverse fundamental education, engineering education, technical creativity, multilevel vocational training, transdiscipline's, multidiscipline's, entropy, development.*

At the World conference of UNESCO which was taking place in Paris in July, 2009, it was noted that education is the most important support of human rights, the democracies, and a sustainable development of the world and therefore has to become available to those who wishes to study throughout all the life. Coordination and cooperation between various levels and the education directions are necessary for implementation of this requirement, especially between average (full) the general, initial, average and the highest professional, and also between schools, lyceums, colleges and universities.

Ensuring equal access to the higher education has to be based on strengthening of its communications with other steps of education, especially with an average. The higher education in this case is considered as a component of system which originates in preschool and primary education and includes all intermediate steps which "passing" has to be irrespective of time and age so that education was continued so much time, how many it is required being trained.

The role of the leader of transformation and development of all education system is assigned to higher educational institutions for the successful solution of this problem. In this regard the higher education institution needs to be competent at all steps of system, closely to cooperate with schools, to participate in joint development of curricula, programs, methodical ensuring educational process and researches in the field of pedagogical education.

All links of educational system have to be constructed so that access to the higher education irrespective of the chosen trajectory of training was provided. In tendencies of development of modern professional education: competence-based approach when forming an educational program, a fundamentalization and humanitarization of scientific knowledge in the conditions of fast change of achievements of science, equipment and technologies, broad and deep integration of education with science and production, is found a number of contradictions the main thing among which, from our point of view, is the contradiction between objective need of achievement of a continuity of training of the expert for professional educational institution and an insufficient readiness of theoretical and practical bases of integration of all its levels in uniform space of preparation depending on abilities and desires of trainees.

The aspiration to find a way of permission of this contradiction inevitably faces need of a solution, as well as on what theoretical and practical base it is possible to design system of continuous vocational training which will allow to realize idea of a multilevelness in one educational institution with uniform educational space.

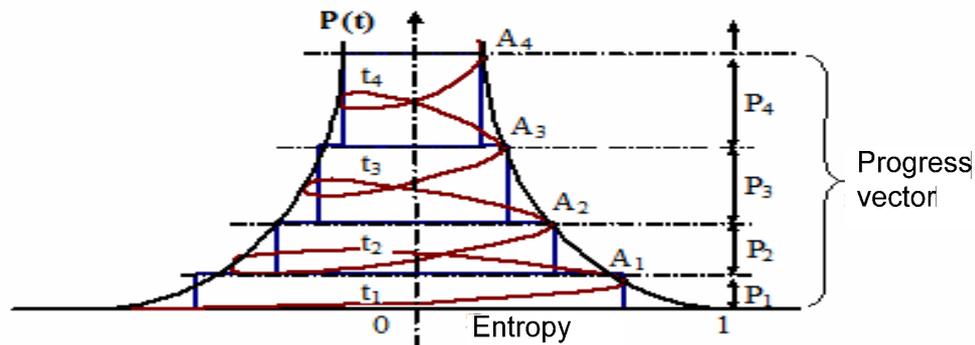
At design of system of continuous multilevel vocational training, we recognize that adequate understanding of the world in which we live, laws of development of society, knowledge, education, it is possible if, being guided by dialectics laws to integrate achievements of informatics, the theory of

management, biology, genetics, thermodynamics, synergetic which use the principle of systemacity, heterogeneity, nonlinearity and consider the world as spontaneous nonlinear open system. This approach is confirmed in chemistry, physics, biology, equipment, economy and other sciences. 1, 2.

Historical experience shows that the processes happening in development of society, it is possible to present in the form of purposeful information and administrative process. Development as a whole is represented as fight of two opposite tendencies: the organizations and the disorganization, being characterized respectively information and entropy.

If development as it is represented by a number of researchers and scientists to consider as fight of two contrasts - the organizations and disorganization, it can be described in a general view as accumulation of the structural information determined by a difference between maximum and real by values of entropy.

The model of development (fig. 1) constructed in coordinates of entropy -



*Fig. 1. Model of development (self-organization) information structures*

At the end of self-organization process when the structure ("architecture") of object or system generally was defined, there come saturation by information and the spiral gradually "becomes straight", reflecting transition of object, system to an evolutionary stage of development.

Helicoids, a meeting form the development model adequately reflects also thinking process. For example, any creative process begins with sketchy, as a rule, disorder data, i.e. with the maximum entropy. In process of accumulation and processing of information there is a working off of idea (hypothesis), there are finds and inspirations which "jumps" draw in detail object structure, i.e. the quantum leap

is caused by proliferation of a variety. The final stage connected with "polishing" and

information with introduction of parameters of time and the progress, in detail described and proved by Abdeev R.F, 1 gives adequate display of developments and shows:

1. The beginning of formation of new structure of system or object begins with real-life, as rule, maximum, entropy (chaos, uncertainty).
2. The number of spiral turns of development is limited to a stage of the transient having helicoids (oscillatory) character.
3. Eventually level of the organization of object or system increases.
4. Meeting character of a spiral by analogy to oscillatory process means aspiration of system or object to an equilibrium state.
5. The meeting spiral with a variable step reflects nonlinearity of processes of self-organization.

operational development of received result, has evolutionary character 1.

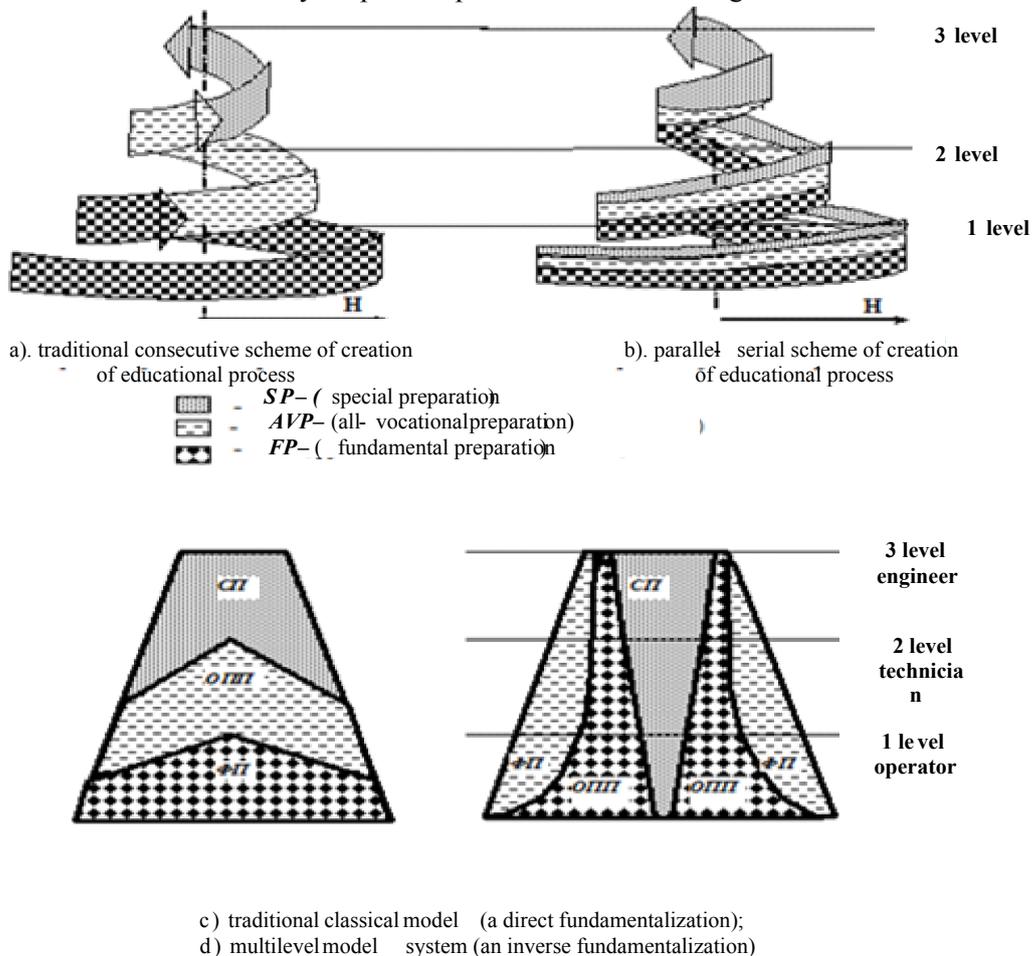
It is similarly possible to present and process of training of the expert in technical college. The beginning of preparation is characterized by rather great value of entropy, i.e. absence of information - knowledge of natural-science, humanitarian and special disciplines. Logical creation of process of training in the higher education institution, for the solution of practical tasks leads providing continuous accumulation of theoretical knowledge and practical abilities, i.e. abilities of application of theoretical knowledge to formation of the expert corresponding to external conditions (inquiries of a labor market). Further professional growth of the expert in this (engineering) field of activity has evolutionary character.

Development of the personality as systems of high level of the organization is connected with such kinds of activity, as the doctrine, knowledge, communication. In development there is a complication of structure of object, level of its organization raises. In this case development has progressive evolutionary character (contrary to regression, degradation). Difficult systems, as a rule, develop unevenly. Cases when one qualities of object progress are possible even, and others degrade. Development in a broad sense is an evolution synonym. The idea of evolution as natural change of the world is rather young; it arose in XIX an century. The idea of evolution extended and in culture that allowed to look in a new way at society and at the person.

The popular formulation of the biogenetic law of Ernst Gekkel that repeats ontogenesis (in the curtailed look), the phylogeny, is the most interesting in application to mental development of the person in ontogenesis and a phylogeny: development of the child in many respects repeats

development of humanity, stages of development of an education system.

What communication of development with education? Usually education is understood as three aspects. The first is a property of the personality, the second – process of finding by the identity of this property, the third – the social institute helping citizens to get this property 6. In philosophy distinguish education natural, occurring in the course of daily communication and interaction with environment, the nature, society and concrete groups of people, and organized in which strictly formalized establishments, the social institutes, specially prepared workers are engaged: teachers, tutors, heads, etc. L. N. Tolstoy by analogy allocated education "unconscious, vital" and education "school, conscious" which always are nearby, supplementing each other. John Dewey emphasized that one of the heaviest problems of philosophy of education is the problem of maintenance of balance between informal and formal making educations.



**Fig. 2.** Models of creation of educational process (a, b) and models of systems of training of technical specialists in higher education institution (c, d)

We will use the described model and we will estimate development of the personality at the higher technical school, i.e. process of formation of

knowledge and professional and educational level at traditional (classical) plans of training. Schematically this process can be presented model

(fig. 2 and, c). In classical (artificial) system of training of the expert consecutive studying of cycles of disciplines is provided: FD – fundamental disciplines, OPD – all-professional disciplines, SD – special disciplines. This way of training of the expert, as appears from consideration of the presented model, is based only on "conscious" education when the system of preparation is constructed under the formal logical cornerstone at the heart of which the principle of "a direct fundamentalization" is. At the first grade level only natural-science disciplines making a basis of fundamental preparation accustom, then all-professional (all-engineering) disciplines and only at the final stage of training - special disciplines are studied. The considered scheme absolutely excludes "unconscious, vital" education and in any way doesn't correspond to E.Gekkel's biogenetic law.

It is possible to carry the following to shortcomings of classical system of preparation. Studying in full on the 1st and the 2nd courses of technical college the higher mathematics, physics, the student doesn't feel communication with future professional activity, specialty and, as a result, doesn't see need for studying of many very difficult sections of these disciplines.

On older years when studying disciplines of specialization the student finds need of application of sections of natural-science disciplines (thoroughly forgotten to this time point) for the analysis and synthesis of the processes proceeding in studied objects of equipment.

As an example it is possible to give Bruce Lipton's revelations - the doctor of biology of the USA, widely known today in the scientific environment of estestvoissledovatel the unique views of process of functioning of a cage and all live in our world 7. "In my college taught the general physics at the level available to students not of physical specialties (B. Lipton in 1960 was a student – the biologist). There was one more course – quantum physics, but we are biologists, ran from it as from plague. In our opinion only masochists could, risking to spoil itself estimates, to sign up for this course ... Generally, I decided to go on a simple way and signed up for an introduction course of the general physics ... I understood how I lost much because neglected quantum physics, only in more than ten years after the university termination. It is sure, be led up me to get acquainted with it in student's years, I would come to the biological dissent much earlier".

In the early nineties in Russia at the Tolyatti polytechnic institute (Russia) as a result of work on integration of systems of professional education of various levels the idea of change of structure of system of training of the expert 2 was born. Basis of

such reorganization was Markvardt K.G. proposal. About introduction in the "organized" education system of elements of "natural" education 5. Since the first course, "core" of vocational training for the entire period of the training representing the block or integrated set of special, profile disciplines or disciplines of the direction of preparation (is formed at a two-level education system). The professional standard becomes complicated eventually. On this core the fundamental and all-professional disciplines the gained knowledge on which is a basis and a support of future area of professional activity or specialty "are strung". The core of special disciplines constantly focuses trainees on need of acquisition of concrete knowledge of mathematics, physics, theoretical mechanics, study of the strength of materials, theoretical electrical equipment, etc. for the decision accruing on level of complexity of tasks and specialty problems. Fundamental preparation proceeds to older years where the most difficult sections of mathematics and special sections of physics and other disciplines knowledge on which is demanded by studying of special disciplines and the solution of engineering tasks and problems are studied. In this case the model of training of the expert has the spiral appearance which rounds contain components of all disciplines (fig. 2, d).

Therefore, the offered model of vocational training of the engineer is based on consistently parallel studying of all blocks of disciplines: natural-science (fundamental), all-professional and special at gradual increase of level of complexity of these disciplines (from simple to difficult, more difficult, etc.). Backbone factor when training the expert are one or several special disciplines, defining specialty or the direction of the professional education, studied since the beginning of process of preparation before its termination – implementation of the degree project and its protection. In this case in the course of training it is possible to allocate certain qualitative levels of training of the expert. (Fig. 2) each such level of preparation is defined on models by "the cross section of a spiral" at a stage before evolutionary development. Sections 1, 2, 3, designate intermediate levels of training of the engineer (the qualified worker-operator, the technician, the engineer or the bachelor, the master, the scientist).

Formation of "base" of training of the expert within one qualification level (spiral turn) happens at simultaneous studying of natural-science, all-engineering and special disciplines. (Primary) in training of the expert of each level general-theoretical preparation on natural-science disciplines which repeats in process of transition from one level to another only at higher scientific

level necessary for development of more difficult blocks (sections) of special disciplines, set by the standard or competence of the trainee is defining. Periodically repeating from level to level to studying of natural-science disciplines we will call return consistently – a parallel fundamentalization or "an inverse fundamentalization".

The offered model of system of continuous multilevel vocational training of the expert in higher education institution is a basis of formation of the general maintenance of professional educational programs and integration of educational institutions (technical) various level in uniform educational space of training of specialists.

Advantage of this approach in design of educational space consists in unity of logical creation of educational process in technical educational institution of any level.

The most difficult for realization of continuous multilevel system of professional education, in our opinion, innovative (atypical) approach to formation of educational and methodical complexes is.

At classical form of education the fundamental principle of formation of the content of training is disciplinary approach at which the infinite diverse world of knowledge is divided into separate areas with one characteristic for this variety of the phenomena an object of research. The disciplinary methodology of training is especially effective at formation, development and increasing knowledge and technologies of research in concrete subject domain. However, at the solution of the tasks which are "on a joint of scientific subject domains", there are problems when to have artificially to expand area of disciplinary methodology.

So various interdisciplinary courses and interdisciplinary techniques of studying of the difficult phenomena of world around, for example, "The theory of electromechanical analogies" start appearing when training the electrical and mechanical engineer 3. The phenomenon of interdisciplinary is characteristic for natural development of knowledge of world around due to overcoming of system "isolation" of disciplines bringing to negative consequences both for science and for education.

It is necessary to carry that the solution of tasks becomes possible in one subject domain on the basis of more perfect methods and technologies of other subject domain, as a result of the established intersubject analogies 3 to the advantage of interdisciplinary approach. So the most complex challenges of the mechanics containing nonlinear and distributed elements of mechanical chains, it is

possible rather simply and to solve successfully methods of theoretical electrical equipment.

Naturally, at the solution of problems of concrete discipline she becomes "leader", and the discipline, whose scientific potential is used for the solution of a theoretical or practical task – "conducted". It should be noted that the scientific potential of "conducted" discipline can promote expansion and updating of conceptual and methodological bases of "leading" discipline, improving and enriching its theoretical basis and the contents. For example, solving in a task of mechanics a problem of blow of a driving inertial element about a motionless emphasis it is possible to come to opening new, nonexistent today an element in electrical equipment – "the diode on a charge" 3. This phenomenon is explained by the synergetic principle – transition to openness of spontaneous system.

At the solution of more complex, complex challenges of the nature and society other principle of the organization of receiving and development of scientific knowledge which is possible only on condition of interaction of many various disciplines, received in literature the name "transdisciplinary" and "multidisciplinary" is necessary.

At multidisciplinary or polidistsiplinarnyy approach formation of the generalized picture of an object of research is based on the backbone principle: all disciplinary pictures of an object of research are components of the generalized picture. Thus transfer of methods of research in another doesn't come from one discipline. All disciplines are "autonomous", absolutely independent and necessary when forming the generalized picture of a subject.

Realization of idea of creation on the basis of intersubject communications of interdisciplinary, transdisciplinary and multidisciplinary training courses in higher education institution, on condition of transition to idea of a "inverse" (series-parallel) fundamentalization when forming an educational program, allows to develop conceptual provisions of scientific and methodical system of the multilevel professional directed training in the direction of integration of various levels of training of specialists into uniform educational space. In this case one educational institution (university) is capable to provide high qualitative level of training of modern experts of various ranges (appointment).

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