

## THEORETICAL BASIS FOR ADAPTIVE EDUCATION IN THE ZONE OF NEAREST DEVELOPMENT

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The authors offer providing individually adapted technology to be used under conditions of frontal teaching and realizing mental paradigm of education – technology of adaptive teaching in the zone of nearest development. At that, not only experimental but also theoretical foundations of its validity and reliability are given.

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When analyzing the state order to school in Russia, including higher school, we can admit that within several recent decades it has been constantly changing. During the times of Khrushchev's "thaw" trying "to catch up with and to overcome America" our country put emphasis to science-technical revolution, and "the epoch of STR" demanded from school graduates possessing most up-to-date knowledge and methods of learning. So modernized didactics was needed and our science of education created it and found out corresponding methods of teaching. Thus problem-oriented teaching (A.M. Matyushkin, M.I. Makhmutov), TRIZ – Russian acronym for «Theory of Solving Inventive Problem» – technology by G.S. Altshuller appeared.

But as far as there turned out to be no advanced technologies in the country which were to be taught to the students it was decided to orient education to the formation of from all sides developed person. This state order was met by our science of education with a number of educational technologies, the concept of developing personality (N.A. Menchinskaya) in particular, etc. But

having realized the unreality of the task (is it possible to form everything?) the state order was formulated in a more detailed way. Now it was required to form a harmonically developed person. The difference was that a harmonically developed person had to possess not all positive qualities and phenomena but only those needed by the society at a definite moment. As a result, there appeared optimal education (Y.K. Babanskiy) and personality -oriented education (I.S. Yakimanskaya).

The period of "perestroika" and the transition to market economy washed away and shifted the stresses in the requirements to graduates of educational institutions on the one hand, and demanded from them very quick and precise orientation in a rapidly changing society, on the other hand. "Who possesses information,

possesses the world". And so, the science of education started supporting this position. The society was not called "industrial" any more. And a new type of person alongside with the new unity "soviet nation" was not formed any more. We started to call the society "informational" where computer got a dominating position. Primary school children began to study Informatics and so new methods of teaching (informational) were introduced.

But with all its immense capacities computer is still unable to think. Thinking is so far the ability only of a human being. That is why now we are observing the transition from informational paradigm to mental, sense containing.

The going off of the totalitarian society gave birth to the diversification of education directed to individual development of a person. The state sets only some standard, some general level (for example, GSE – General State Exam), but educational technologies, to provide for the result, are not given "from above". This situation leads to an abundance of various textbooks, methods, programs which are supposed to develop personality of a student. Some of them are not only declarative but sometimes even didactogenic unfortunately. A flow of theories of education (not always high quality) poured into the emerged lacuna. We saw the aim of our investigation in the creation of versified individually adapted technology to be used under conditions of frontal teaching and realizing mental paradigm.

The theory of education worked out by us is based on several psychological laws.

The first of them is systemic character of psyche. It was very well-grounded in the science of education already in classical works by K.D. Ushinsky, L.S. Vygotsky, etc. One of productive steps in this direction was made by N.I. Chuprikova, who formulated the universal fundamental law of mental development – the law of systemic differentiation. Basing on this law in our earlier research works we set

the goal to describe concrete psychological mechanisms and mental development genesis by means of differentiation of the mind structure in students. In those works the hypothesis according to which mental development is going on due to differentiation of main mind substructures was tried and confirmed. And it is a really “childish way” of acquiring not only direct but also indirect forms of the consciousness.

But the substructures differentiation provides only for the initial level of mental development, though sufficient for non-professional activities. Later, higher levels are achieved by constant cyclic changing of differentiation and integration of psychic processes (at the beginning) in the substructures. And then mental development within these substructures takes place on the “upper floors” of its formation.

What is the psychological mechanism of this progress? In the search for the answer to the question it was established in our earlier works that the structure of the mind is the intersection of five main substructures. Their development takes place in the following sequence.

The first are topological representations. They appear in children at the age of three. As our research showed, the first most general non-differentiated mind substructure is formed on this base. We have named it a “topological cluster”. Thanks to it a man starts distinguishing between such characteristics as continuity, coherency, compactness, closeness in objects and relations.

But these rather general characteristics don't let us differentiate homeomorphic objects. Within the framework of topology it is impossible to distinguish between, for example, looking quite differently, a circle and a square, as these figures are both continuous, coherent, compact, and closed. But the social situation of development requires their differentiation from a child. That's why he “learns” to find out and to operate the tolerance phenomena (relations of similarity). Thus the next mental substructure – “projective” is formed in a person. Its invariants are: establishing of similarity between similar objects and their depictions performed in different projections and from different angles, objects and ways (possibilities) to use them differently in different situations.

But it is not enough. As it turns out similar objects can differ noticeably as well. They can differ by their size (bigger, longer), by position (below, in front of, parallel, perpendicular), by form (circular, rectangular, triangular), by temporal characteristics (in the beginning, before, after), etc. So the next “orderly” “cluster devel-

ops as a result of “acquisition” of quasi-, linear and partial putting in good order lots of objects and relations by a person.

But the differentiation goes on. The above mentioned relations and phenomena get better expressed and more precise qualitative characteristics: not simply bigger, but 7sm against 5sm. The result of it is the development of the next “metrical” cluster in the mind, which provides for finding out and operating numerical characteristics of objects.

Then the processes of integration are switched on in the mental development genesis and the law of systemic integration is realized. This “is reflected, firstly in the growth of interrelations between elements and subsystems, and, secondly in that subsystems and elements performing similar functions integrate into more generalized subsystems and elements forming higher levels in the structure of the system” [9; 9]. The result of this mental activity is the development of “compositional (algebraic)” cluster in the mind structure. Thanks to it a person follows and operates composition laws, discovers reversibility of numeral actions and transformations, “contracts” them, performs them in any sequence, substitutes several operations by one, divides and unites (combines) relations and elements, etc. The presence of this cluster in the human mind structure is evidence of its rather high intellectual development level<sup>1</sup> [2, 69–95; 3; 5].

The described clusters are not isolated. They intersect with each other in all mental operations. And always among them there is a major, dominant one. It defines the character and the content of mental actions in the process of decision of this or that task, individual preferences in distinguishing these or those object characteristics and ways of thinking. This substructure turned out to possess a generalization quality: it is actualized and it functions in different situations with different contents. The relation of the dominant substructure with various ways of its use is established in a student's mind. According to our research all students differentiate quite steadily in five groups according to the dominating substructure (cluster) in their mind.

We have discovered that to decide the task, from psychological point of view, first of all,

<sup>1</sup> It should be noted that many of psychologists considered such a phenomenon of the compositional cluster as, for example, reversibility of mental operations to be the “core of cognition” (J. Peaget), intellect (N.A. Menchinskaya), high level of mathematical (V.A. Krutetskiy), geographical (E.N. Kabanova-Meller), physical (Z.I. Kalmikova) type of thinking development, “the field of essence” (V.V. Davidov).

means to “reformulate”, to “translate” it into the “language”, into the terms of your dominant cluster [4; 6]. The point is that, as soon a person manages to “introduce” a task into the framework of his dominant cluster, «lets it in» it, the structural mechanism of thinking, described by S.L. Rubinshtein switches on. The mind begins, in accordance with isomorphic to the cluster relations laws, actively transform, “reformulate” the task, “excavating” from the object more and more new content; as if it is turning to another side each time, and thus, demonstrating its new characteristics [8, 99].

In other words, it can be assumed that the real comprehension of the task content, and its decision is achieved by the student, only if he succeeds to consequently “put it right” and to expound it within the frames of his dominant cluster [4]. So it is not hard to assume that the effectiveness of teaching is achieved if the teacher expounds the material in the “language” adequate to the cluster of each of his students. But here is a quite natural question about possibility of building up and realization of such tuition in a group (class-lesson system). On the one hand it is just impossible to give the same material five times running within the frames of different clusters, or in five “languages” simultaneously. On the other hand the teacher himself would involuntary tend to decide the task and to expound the material in the way isomorphic to his own dominant cluster, which is different to the cluster of the majority of his students. The situation seems to be hopeless. According to the hypothesis of this research work our specially developed technology gives the solution. This technology performing integrative function in teaching is “the technology of adaptive teaching in the zone of the nearest development”.

It is based on the following principles.

1. Teaching is built up on the organization of the research activity of students.
2. The teacher occupies the position of a “social organizer” of their cognitive activity.
3. When organizing the students’ cognitive activity the teacher doesn’t speak in a narrative way except for when introducing new terms. All the teacher’s addresses to his students are formulated only in the interrogative form.
4. The questions to the students are not planned in advance.
5. They are not formulated intuitively or voluntary, but according to the strict algorithm.
6. The algorithm is as follows. In the last narrative sentence of the student (his answer to the question) the teacher chooses a key word – the word bearing the major sense loading and

formulates a question to this word. For example, the student answers: “I think it is necessary to go”. The key word here is “to go”. It is the word to which the question is formulated: “Why go?”<sup>2</sup> The student gives his answer. The teacher again asks a question to the key word from the student’s new answer, and so on, until the student himself comes to the solution.

It is clear that the student formulates his answer, its meaning within the frames of his dominant cluster. Asking the question to the main meaningful (key) student’s notion, the teacher minimizes the possibility of his question formulation to escape the frames of his student dominant and involuntary finds himself within his student cluster. So the question becomes understandable not only for the student who answered but for all other students with the same dominant cluster. During the dialogue (frontal or individual) a natural consequent chain of conclusions is being built and it leads to the teacher-planned result.

Those with other dominants are trying to paraphrase the dialogue and to insert it in the frames of their substructures. If they can’t do it on the spot, they apply to the teacher or to the classmates. As a rule, one or two replies from the teacher or from the classmates with the same dominant are enough to remove the difficulty and to advance him to the next logical stage. During the heuristic dialogue it’s rather easy to discover everybody’s place of intellectual difficulty. And everyone “gets out” of it very quickly again with the teacher’s question addressed to the key word, or with the comments of the classmates with the same dominant. Thus the question about methods of frontal work with the students having different clusters is removed.

But there is another problem. If the teacher creates for the students conditions which are adaptive from the point of view of mental development and works with everyone in his dominant cluster can there be some slant? Will everyone develop only one dominant cluster, but not the others? This question can also be answered negatively. And for such an assertion there are other theoretical foundations besides our verification. The thesis about continual-genetic (non-disjunctive) nature of the psyche can be referred to such foundations [8; 1]. According to this thesis, «thinking as a real, live process is not disjunctive ... Different stages ... are interconnected so tightly, so intrinsically, that ... continually seem to penetrate each other, fuse, genetically transform one into another, etc.» [1, 13] It means that

<sup>2</sup> You can learn about this technology in more details, for example, in our works [3; 7].

when one cluster is developing other (all the rest) clusters are developing too, so general mental development is going on<sup>3</sup>.

Since the student in such tuition is constantly leaning on and operates non-dominant clusters (thus developing them) he is forced to

Number	Criterion	Traditional tuition	Adaptive technology of mental development
1	Teacher's function	"a guide", "a rickshaw", To be ahead of students <sup>4</sup>	A "social organizer" <sup>4</sup> , To be behind, to follow students
2	Teacher's position	Formational (egocentric): the teacher "reads in", "writes in" his student into himself	Personality-oriented (off-centric): the teacher «reads out» of his student and takes him into himself
3	Character of teacher-student interrelations	the teacher goes to the students with his subject, his academic discipline	the teacher goes to the subject, academic discipline together with his students
4	Educational trajectory	Is set by the teacher	Is chosen by the student
5	The main principle of students' mental development	Purposeful impact on the students' intellect to form mental abilities corresponding to the norm and set in advance	Creation of conditions (social situation of development) for students' intellectual self-development
6	Orientation	To successfulness of the activities (increase in volume and speed of information processing, ability to decide many complicated tasks)	To realization of individual mental resources (competence, initiative, creativity, mental self-regulation, independent choice of learning methods, ability to work with discrepant, paradoxical information, dialogical thinking)
7	Support	Individual psychological peculiarities of each student	Common laws and mental development genesis at a given age period
8	Formation of action and knowledge operating method	Offered by the teacher, or discovered under his leadership the one and the only true method «scientifically grounded», which can be really their own for only some students	A student under the leadership of the teacher builds his own method, which he believes in and is sure in its scientific foundation
9	Cognitive activity	Prevalence of verbal knowledge and thinking ways as a result of verbal-logical method of tuition and a place in the world given by the adults	Prevalence of non-verbal knowledge and thinking ways as a result of their own acquisition and their own defining of their place in the world
10	Thinking – memory ratio	Students remember, understand the instruction and try to act in accordance with it. The leading process is memory	Students discover and create their own action algorithm, method of acting. The leading process is thinking
11	The world picture	Adequate to the offered (by teacher or book) or to reality reflected in a student by scientific knowledge acquisition	Non-adequate, abundant, including what doesn't exist yet, and what possibly will never be. The result of student's own construction and generation
12	Existence methods	Adaptation to the surrounding world	Constant search approbation and testing of the self in the world

<sup>3</sup> Generally speaking this is characteristic of all living beings. It can easily be observed on the example of sportsmen. Thus in those doing lawn tennis and operating mostly only one arm the other arm is also developing. The man doesn't become asymmetric.

<sup>4</sup> According to L.S. Vygotskiy's terminology.

be in his individual zone of the nearest development (L.S. Vygotsky).

Lasting for many years, experimental approbation of the described technology in Novgorod, Ivanovo, and Nizhniy Novgorod regions proved to be highly effective. In comparison with traditional tuition our approach called “adaptive technology of mental development” has a number of advantages, which we present in the conclusion.

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