

Iteration as a Regulatory Function of Education Management

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ABSTRACT

The external and internal environment's high turbulence in the education system and its entity's activity make the measures taken and development programs insufficiently productive, which reduces the education social impact and its economic productivity. The authors believe that the management of education development requires flexible adaptive mechanisms creation capable to preserve the system's functional in a varieties environment. The iteration allows solving this task, as a control function, consisting in regulatory mechanisms controllable connection in case of the criterion parameters deviations in functioning from established norms. The iteration possibilities in achieving the education target results at all levels are shown, which allows implementing the established mission projection of the higher education system. Iteration realization gives an understanding of the deviations nature, education risks identification, which allows timely adjustments in the development path. The paper is intended for researchers, heads of managerial educational structures.

Keywords: education reform, methodology, management, development, iteration, iterative approach

INTRODUCTION

Historical experience convinces that modernization is not only the system progress, but also its actualization, the emergence of fundamentally new contradictions and previously existing ones consideration. In the most general form, the reforming problem in the Russian professional education can be formulated as follows: Russia's self-determination from the view point of general principled directions in the education development [1, 2]. This urgent problem, at present time is clearly visible, on the one hand, because of different opposite views on the meaning of reform, and on the other, various models' uncritical adaptation increase tendency in education, formed on other cultural traditions, conditions and attitudes basis, which can lead to the rejection of education reform from the cultural traditions in Russia, its ability to self-development [3, 4]. An integrated reason that calls for a new look at the education's place and role as a public institution is the growing discrepancy between the increased requirements for education level and quality and the theoretical and methodological study of these problems and, as a consequence, problems in practice that try to find by the trials' and errors' method the way to solve this problem [5, 6, 7]. Unclear and weakly resolved in this context, the following points are considered: firstly, there is no well-defined, clear educational doctrine and education strategy, especially the junctions between elements or education levels are problematic: pre-school educational institutions and primary school, primary and secondary schools, secondary general education school and vocational educational institutions (colleges, lyceums, universities, etc.), educational organizations and external structures, having educational potential, but due to their insufficient integration into the pedagogical environment, inefficiently used [8, 9, 10 11, 12, 13].

Secondly, lacking a central, system-forming idea, the curricula and programs in many schools trying to innovate the educational process, are characterized by the lack of systemic nature, eclecticism, the desire to embrace the vast, depriving students of an integral scientific world picture, losing the most important quality - the fundamentality of knowledge, which is the basis, and which is capable of enabling students to cultivate new, missing knowledge. Often in connection with the lack of their methodological ideas, there is an unjustified transfer of unapproved, mostly foreign methods into the domestic education system, which turn out to be poor and ineffective [14, 15]. They are not so because they are bad in principle, but because they are bad in specific conditions (they are designed for a certain training of a teacher who, in our conditions, possesses it, for a different cognitive and psychological students training, for another educational and technological context and etc.).

Thirdly, there is often students' excessively early specialization to the detriment of the minimum necessary basic general education. In addition, the combination of such "specialization" and traditional training is aimed at informational "pumping" in the knowledge field and the inculcation of certain normative private skills from the sphere of the supposedly chosen specialization. The student in this context acts as a reservoir, filled arbitrarily and according to the teacher's subjective feelings. It is possible to speak about personality development in such a school only in a declarative way, since the goals of personal development are set in a technological formulation, neither development mechanisms nor methods for diagnosing the trainees' development nor documented parameters have the character of an integral system and are not mandatory [16, 17].

Fourthly, the traditional organization of education and upbringing is built on a technocratic approach that manifests itself:

- in the technocratic knowledge dominance in curricula and programs in the explicit and hidden kinds (about the external world in relation to man). An explicit or implicit manifestation of this tendency is in the dominance of both: the time of study and the scope of the relevant disciplines, the implicit one is in the "technocratic" way of submitting that knowledge, which in fact is the humanitarian knowledge.

Far from being realized is the human potential that is contained in the research and experience of domestic contemporary psychologists and teachers [18, 19, 20, 21, 22]

The new school philosophy (school in a broad sense) is based on the following postulates of the humanistic (entity-entity) education paradigm [23, 24, 25]:

- the postulate of the individual's integrity and indivisibility, the unity of the general, the special and the particular in each person;
- the postulate of the active instrumental-sign nature of the mental capacity of the higher mental functions and abilities of man;
- postulate of the apperceptive nature of acquiring personal experience;
- the postulate of personal properties' plasticity (variability);
- the postulate of personality development in the course and result of innate development programs' interaction with the surrounding world of nature, things, social attitudes, with the world of culture;
- the postulate of the student personality self-worth, who has the natural right to choose his or her own logic and trajectory for development (self-development).

Innovative processes generate negative factors - many reform models that have not been critically selected, domestic educational traditions transformation, the lack of activities unification and the external environment stability inherent in the centralized management previous stage. The need to change traditional approaches to the vocational education management, the development conceptual bases changing requires the methodology development that can be a functional of the system with an unpredictability and low predictability high degree [26, 27, 28, 29].

The goal of education innovative development should be the conditions and mechanisms formation for the vocational education system sustainable development, which:

- provide qualitative changes in vocational education, the education system and educational environments to enable a person to develop in a multifaceted nature as a spiritual, creative and healthy personality in accordance with the modern development requirements;
- will promote effective, competitive and sustainable socio-economic development;
- fully take into account the public request from the population various groups;
- will meet the development trends of modern Russia as a leading participant in global economic, political and social changes in the world.

Such conditions cannot be conceptually satisfied by existing methodological approaches - systemic, process, project and competency based, etc. In conditions of the external environment high turbulence, only those systems can be productive, which are based on the managerial adaptive mechanism that allows the system to function and evolve, while the system essential basis must remain unchangeable.

METHODOLOGICAL FRAMEWORK

Socio-economic processes mobility requires the vocational education system to have greater flexibility, speed and reactions adequacy, stipulating the task of strategic and operational management. Achieving the necessary vocational education quality level, reflected in the third-generation standards and labor market requirements, requires innovation, both in the educational process itself and in its management [30].

This situation makes an iterative approach to the pedagogical projects design and implementation in demand. Iterative approach (English iteration - repetition) - activities implementation followed by the continuous analysis of the results obtained and the activities previous stages adjustment.

The iterative approach proposed by the authors, the essence of which lies in the internal accommodation (adaptation), provides the regulatory mechanisms controllable connection in the event of the criterion parameters deviations in the system from the established norms.

The principles system for the vocational education iterative development includes:

- the transversality principle;
- the principle of vocational education advanced development;
- the principle of vocational education development innovative projecting;
- the principle of the vocational education system openness and public participation in its functioning;
- the principle of education continuity (permanence);
- the principle of targeted strategic investment;
- the principle of the educational environment's innovative nature;
- the principle of competency-oriented base of vocational education innovation;
- the fractality principle;
- principle of indicative nature of management and control

One can consider the content of these principles in more detail.

The Transversality Principle

The transversality principle is a fundamental idea and strategy of national educational systems innovation in the conditions of the world educational space formation, based on the cultural diversity preservation, contributes to the society development economic foundations integration with its educational, social and environmental pillars.

The Principle of Vocational Education Advanced Development

The principle of educational advanced development is used as an adequate response to requests, conditioned by the basic directions of socio-economic development. This principle means the education system mobile reorientation to train persons for life in the rapidly changing conditions of social and economic processes intensive development and a new life quality ready promptly to offer their participation, responding to the society and the labor market demands and ensuring the competitiveness of the domestic vocational education system.

The Principle of Vocational Education Development Innovative Projecting

This principle means that innovative development in education must be based on new approaches. Traditional sector and program approaches do not have time to respond to rapidly changing changes in society, the country and the world, or they react with a large delay lag. Realizing and taking into account the current trends in the country and the region development, it is necessary to project in education the processes that are transparent to these changes today.

The principle of educational innovative development projecting involves the projects development and implementation that are already directed to the future - the educational sustainable strategic development.

Principle of Education Openness and Public Participation

The educational development is not so much an institutional and administrative process as a strategic direction for the whole society development, affecting each person interests. This principle presupposes the public consent achievement, on the basis of which power, society, business, public organizations and the professional pedagogical community commit themselves to the innovative educational processes joint promotion. The achieved public consent will allow constructing all entities' constructive mutually beneficial relations, which will ensure the necessary changes in such a complex socio-economic sphere as education.

The Principle of Education Continuity (Permanence)

The modern world is characterized by the transition to global processes, the most important role in which will be played by human knowledge and competencies based on them. The persons' continuous education throughout their lives is the society mobility main factor, its readiness for predictable changes. The person's opportunities provision by the state and society to constantly develop and educate regardless of age, health status and other factors contributes to the social relations harmonization through fair knowledge redistribution as the basic human capital. Capital knowledge's possession allows persons effectively to organize and manage their own life, ensures the rights of all to self-realization.

Continuity, as applied to an integral educational system, involves reflection in all its components of integration, the learning and reality unity, in all its manifestations diversity, training and productive labor, general and vocational education. On this basis, knowledge continuous updating, and hence the instruction's all means, ensures an ever-increasing orientation of the younger generation towards the readiness formation for self-education and creativity. This principle implementation is an important condition for vocational education system to carry out social functions such as social protection, social and professional adaptation.

The Principle of Targeted Strategic Investment

In the modern post-industrial information society, the human education level has a direct impact on the quality of the created social product and its competitiveness. The main person competitive quality is his or her knowledge and competence, social and professional mobility, the ability to initiate or support innovative production and management technologies, the progressive processes of social development, and actively participate in their implementation. If the society wants to develop long-term, its strategic investments should be directed to education, including vocational education.

The Principle of the Educational Environment's Innovative Nature

Openness and rapid response to changes in the education system is the most important condition for the educational environment productivity formation. Being one of the educational environment's main entities, educational institutions and organizations become active participants in a variety of interactions, which brings new qualities to their activities.

The Principle of Competency-Oriented Base of Vocational Education Innovation

The competency based approach is an attempt to align vocational education and labor market needs, i.e. is connected with the order for education by employers - those who need a competent specialist. This is possible only when education becomes the student's personally significant activity. This is an approach where the educational results are recognized as significant ones outside the education system. The competency based approach is an approach that focuses on the educational results, and as a result, not the acquired information sum, but the person's ability to act in various problem situations is considered. These situations type depends on the educational institution type, for vocational educational institutions - on the activity types defined by the standard of future specialists' specialty. The competency based approach is currently specified by the requirements for a specialist on the state educational standards basis.

The Fractality Principle

The word "fractality" appeared in the scientific literature relatively recently. Our contemporary mathematician Benoit Mandelbrot invented the word (from the Latin "fractus" - fractional, not an integer), in 1975 to designate irregular but self-similar structures. B. Mandelbrot drew attention to the phenomenon that for all its obviousness eluded his predecessors: the contours, surfaces and volumes of the objects around us are not as smooth, polished and perfect as is commonly thought. In the modern mathematics arsenal, Mandelbrot found a convenient quantitative measure of the non-ideality of objects - the tortuous structure of the contour, the wrinkling of the surface, the fracturing, and the porosity of the volume. It was proposed by two mathematicians: Felix Hausdorff (1868-1942) and Abram Samoilovich Besicovitch (1891-1970). Now it deserves its creators names (the Hausdorff-Besicovitch dimension). The Hausdorff-Besicovitch dimension in application to the ideal objects of classical Euclidean geometry gave the same numerical values as the well-known long before it the so-called topological dimension (in other words, it was zero for a point, one for a smooth running line, two for a figure and a surface, three for body and space). But, coinciding with the old, topological dimensionality on ideal objects, the new dimension possessed a more subtle sensitivity to all kinds of real objects imperfections, allowing distinguishing and individualizing what previously was faceless and indistinguishable. But the most unusual thing about Hausdorff-Besicovitch's dimension was that it could take not only integers, as topological dimension, but also

fractional values. Mandelbrot and invented his neologism, calling it fractal dimension to emphasize the Hausdorff-Bezikovitch dimension ability to take fractional, non-integral values. Then the world objects property of fractality was justified in synergy. "Fractals are those objects that have the property of self-similarity, or, as they say, they possess scale invariance. This means that a small fragment of the structure in such an object is similar to another, a larger fragment or even a structure as a whole."

As a result of interaction between mechanisms for replicating innovations and "classical" allocation factors, a system formation complex process develops, when self-similar structures (fractals) forming and propagating, superimposing on the basic heterogeneity, form a complex picture of fractal geometry of the space.

The Principle of Indicative Nature of Management and Control

An important link in the accompanying process of the assessment and quality control system is the methodology for determining the functioning effectiveness of both the entire vocational education system and its individual modules and elements. Only on a deep methodological basis can we create the information level that is necessary for making pedagogically meaningful and economically justified decisions. The main feature of modern research is the transition to the cyclic methodology of forecasting and planning, based on the cyclical development as a fundamental property of progressive socio-economic and scientific and technological development. At present, obviously, we can talk about the emerging paradigm of cyclic nature in science and scientific thinking, which supplies the methodological basis for ensuring the thinking "non-linearity", forecasting and planning.

RESULTS AND DISCUSSIONS

In this situation, the mechanism of iteration to design and implement pedagogical projects becomes especially important. Iterative processes - cyclical work in parallel with the obtained results' continuous analysis and the work previous stages adjustment. The project within these processes in development's each phase is recurring Deming cycle: planning - implementation - verification - assessment.

Iterative processes in vocational education different levels have the following advantages: reduction the serious risks impact in the project's early stages, leading to expenses' preemption and minimization for their elimination; the effective feedback organization between the project team and the customer (as well as with all interested agents) and a product creation that meets his needs; efforts focus on the most important and critical areas of the project; continuous iterative testing allowing one to assess the success of the project; early detection of conflicts between requirements, models and implementation of the project; a more even participation capacity of the project participants; effective use of lessons learned; a realistic assessment of the project current status and, consequently, customers' and direct participants' greater confidence in its successful completion; the costs are allocated across the project and not grouped at the end. Proposed mechanisms make organic synthesis of pedagogical problems solution in methodology, theory and practice of vocational education. The iteration mechanisms, therefore, represent a sensitive scientific projection instrument for coordination reactions of vocational schools' and the socio-economic spheres development.

The iterations procedure in this model provides not only the development stage with already "obtained" results and knowledge, but also the starting point changes - the "continuous improvement" implementation. The iterative approach key idea is the existing resources synthesizing and the future system's image, formed by foresight technologies. The indicators variability analysis in education strategic development (educational structures and technologies) involves obtaining and analyzing the integrated indicators boundary values; taking into account the received foresight knowledge, the next iteration is carried out. At each iteration, the planned actions are carried out, the criteria and boundaries for strategic planning (development) are clarified, the degree of the planned results' achievement and the feasibility of the strategy are determined.

The initial information for subsequent iterations is extracted from the project progress during the previous iteration's monitoring phase. For each initial iteration point, the overall strategy, the current iteration task, solved through the project implementation, the general requirements for the benchmarks values and the criteria for selecting the emerging strategic alternatives when the external environment changes, which are formed based on foresight, should be determined.

Thus, the proposed iterative model can be used as an implementation method of large social structures' strategic development (the educational system) providing the following advantages:

- the possibility to use in time constraints in the presence of foresight - studies of the external environment;
- possible alternatives' range limitation in connection with the task to satisfy stakeholders, to identify the problems of interests optimal balance;
- the Potential of functioning in the unstable external environment in relation to adaptation at each iteration step;

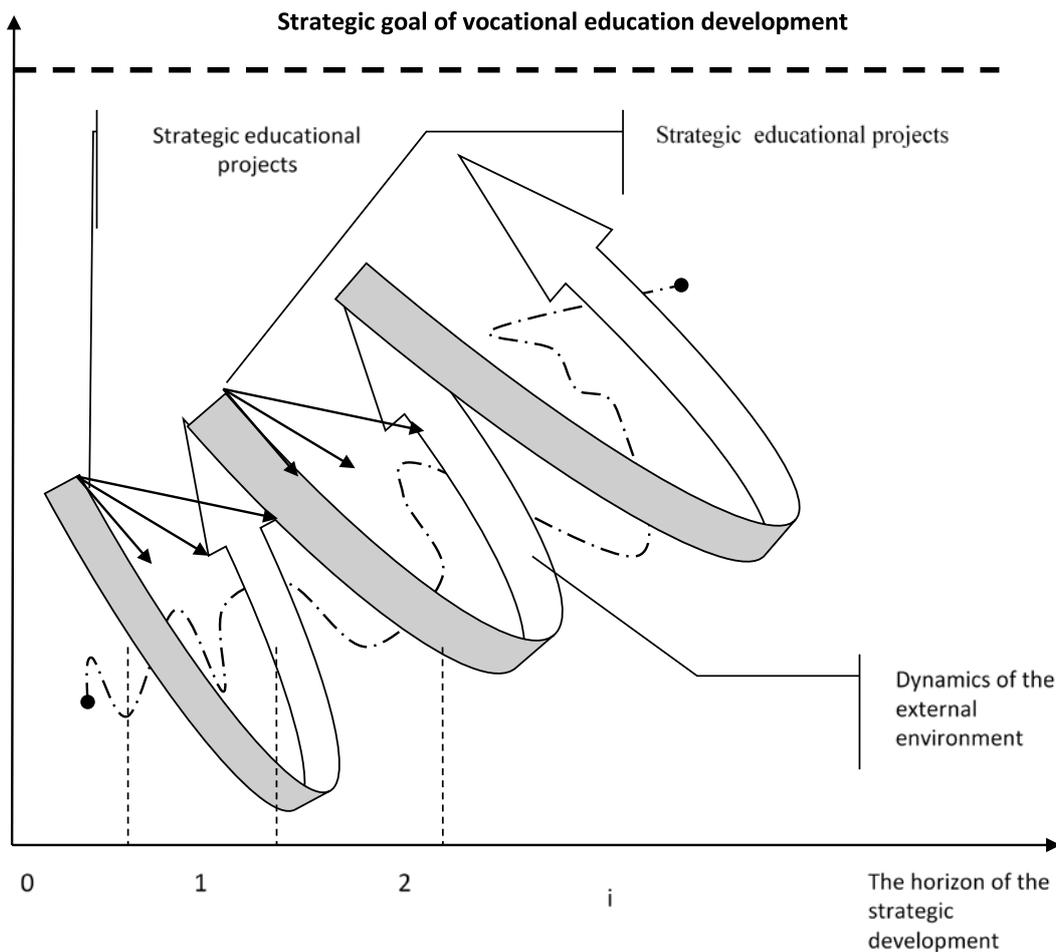


Figure 1. Scheme of strategic iterations in vocational education

- risks management when on the one hand the step-by-step strategy implementation decreases their appearance, but on the other hand, in the presence of external conditions, there exists the possibility of obtaining quick results, e.g., the implementation of highly innovative projects;
- formalized automated management and monitoring of development.

The iterative approach allows creating “road maps” for the education development that is, determining the semantic reference points (via indicators) on the time axis. In the modern education methodology, iteration can claim the status of a meta-concept, since iterations as a phenomenon are found at different levels (psychophysiology, psychology of cognitive processes, management theory, etc.)

The iterative approach use makes it possible to define the vocational education system’s development as a set of iterative cycles and procedures’ set that require implementation (the definition of an innovative development vector, the search for real development opportunities for determining the objects of activity and its planning, the organization and evaluation of the possible positive effects from professional education agents’ joint pedagogical, organizational and managerial activity; evaluation of strategic alternatives; monitoring of the implementation of the strategic plan’s continuous interaction with the operational planning within the iterative loop system).

System-forming element of this approach is the iterative cycles in the educational system [33]:

- generalization level (education in general): continuing education, education level; system of upbringing;
- stratagem level (educational organization): strategic vision, mission, strategic plan, quality management system;
- the educational process level (organization of instruction): the curriculum and the program, module, discipline;
- implementation level: academic year, semester, discipline, lesson.

The iteration initiation (cycle start) for each level is different and can be defined by global factors (e.g. the educational paradigm change) and local ones (e.g., the standard requirements to the student competence level);

iteration increment (implementation recurrence) is determined by the time category and system status (by each its participant) at this point of time. Within the iterative cycles, the quality management system implementation based on the principle of continuous improvement and based on the Deming cycle is fully carried out, which allows to broadcast the strategic vision for all pedagogical processes with step-by-step approximation, error estimation and system regulation, innovative processes transformation in case of overcoming limitations. The planned targets of the innovative processes implemented in the educational system are constantly monitored in order to avoid gaps between the strategic direction and operational actions, each change being subjected to a serious assessment of its influence degree on the strategic vision of the system. Negative factors analysis is a way to improve the processes at the next iteration of the cycle. The educational processes indicators' planned values obviously must have established boundaries and high sensitivity.

Determination of the causes, properties and regularities of vocational education development processes in one iteration cycle provides an understanding of the deviations nature, possible risks (loss of processes and their results), and knowledge on the development method and determines the possible direction for improvement, that is, continuous monitoring of the results within one iteration cycle takes place. Indicators of vocational education development processes after going through several iterative improvement cycles become a "standard". The indicators system of processes' and projects' development demonstrates the level of vocational education development in general, while the assessment of these indicators can be performed at a certain time interval and diagnose the approach to the planned values, when each iteration cycle moves to achieve the desired results. Such an interpretation allows the projection of the educational system's established mission on all its levels, processes and entities [34].

Thus, on the basis of the iterative approach, continuous learning and development is carried out, as the practices of learning from our own mistakes, a consistent approach to the planned goal, taking into account the corrective stages through iteration cycles.

The advantages of the iterative approach: serious risks' impact reduction in the early stages of the project, which leads to pre-emption and minimization of expenses for their elimination; the project team's effective feedback organization with the customer (as well as with all interested agents) and creating a product that meets their needs; efforts focus on the most important and critical areas of the project; continuous iterative testing allowing to assess the success of the whole project; early detection of conflicts between the project's requirements, models and implementation; a more even participating of the project participants; effective use of lessons learned; a realistic assessment of the current status of the project and, consequently, customers and direct participants greater confidence in its successful completion; the costs are allocated across the project and not grouped at the end.

The development of the iterative approach in pedagogical science and its introduction into the practice of vocational education system's development management is due to the innovative nature of continuous changes in the external and internal environment aimed at ensuring compliance with current social and economic requirements [35, 36, 37, 38, 39].

Reforming of the vocational education system provides for its components' periodic updating (documentation, standards, content, technologies, etc.) in connection with changes in technological, economic, social spheres while ensuring the quality of the finished product-graduate. The development of the vocational education system causes the presence of multiple innovative processes, the course of which must be monitored within the framework of the entire system's development. The iterative approach allows regulating the new methods', technologies', processes' implementation in the system of vocational education gradually, within specified iterative cycles with the result's approaching tracking to the planned one. Timely adjustment of the innovative processes' course will avoid negative manifestations of reforms at early implementation stages.

CONCLUSION

The iterative approach is a sensitive scientific and projecting tool to coordinate the vocational school development and socio-economic sphere, organically synthesizing the pedagogical problems solution in the vocational education's methodology, theory and praxeology.

Actually, the iterative approach makes it possible to unite all the problematic aspects of the methodological level for the efforts implementation in theory, technology and practice for accompanying the vocational education development. The iterative approach peculiarities allow consideration of different-scale educational processes from a single position, which, in turn, makes it much easier to find psychological and pedagogical ways out of situations with unpredictable results. In general, the iterative approach features are in demand in conditions of technologies' intensive change in the production and education sectors.

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