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Methodological and practical aspects of pedagogical innovation logistics application in the regional educational holding

МЕТОДОЛОГИЧЕСКИЕ И ПРИКЛАДНЫЕ АСПЕКТЫ ПРИМЕНЕНИЯ ЛОГИСТИКИ ПЕДАГОГИЧЕСКИХ ИННОВАЦИЙ В РЕГИОНАЛЬНОМ ОБРАЗОВАТЕЛЬНОМ ХОЛДИНГЕ

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Written by:

Sergey Danilov¹¹<https://orcid.org/0000-0002-1022-5049>**Margarita Lukyanova¹²**<https://orcid.org/0000-0002-1738-4667>**Irina Aryabkina¹³**<https://orcid.org/0000-0002-8765-2153>

Abstract

Transition to a post-industrial society determines the development of an educational system through innovations. To address the related issues, we need a methodology lined up with the post-industrial society and capable of maintaining effective innovation management in education. Creation of much-in-demand, competitive, and economically attractive educational innovations is largely associated with combined efforts of several educational organizations. Once merged in a territorial educational cluster, they establish conditions for a complete innovation life cycle. A driving mechanism for innovations to move throughout the entire life cycle is logistics. So far, two scientific positions have been formed in relation to the use of logistics in education. The first position is represented by educational logistics aimed at sustainable functioning of the educational system infrastructure. The second one encompasses pedagogical logistics, which facilitates effectiveness and quality of the teaching and educational process. None of them aim at development of an educational organization or its pedagogical system being implemented. Boosting the situation already in place could be done through integration of the educational and pedagogical logistics' achievements supplemented by the idea to develop an educational infrastructure with a pedagogical system already in place into

Аннотация.

Переход постиндустриальной формации общественного устройства определяет развитие системы образования путем нововведений. Решение соответствующих задач требует релевантной постиндустриальному обществу методологии, которая сможет обеспечить эффективное управление инновациями в образовании. Создание востребованных, конкурентоспособных и экономически привлекательных образовательных новшеств в большинстве случаев связано с консолидацией усилий нескольких образовательных организаций. Объединившись в территориальный образовательный кластер, они создают условия для полного жизненного цикла инноваций. Механизмом, обеспечивающим движение инноваций на протяжении всего жизненного цикла, является логистика. Сегодня сформировались две позиции относительно применения логистики в образовании. Первая представлена образовательной логистикой, нацеленной на устойчивое функционирование инфраструктуры образовательной системы. Вторая – педагогической логистикой, обеспечивающей воспроизводство эффективности и качества учебно-воспитательного процесса. Ни одна из них не ставит своей целью развитие образовательной организации и реализующейся в ней

¹¹ Candidate of Pedagogical Sciences, docent of the Ulyanovsk State Pedagogical University, Russian Federation

¹² The doctor of pedagogical sciences, professor of the Ulyanovsk State Pedagogical University, Russian Federation

¹³ The doctor of pedagogical sciences, professor of the Ulyanovsk State Pedagogical University, Russian Federation

pedagogical innovation logistics. This logistics serves as a methodological basis of pedagogical innovations management in education. The scope of such logistics is a territorial educational cluster; its subject is infrastructural, educational, integrative flows, a flow of obstacles, and a pedagogical innovation flow. As a matter of applicability, the efficiency of pedagogical innovation logistics has been tested with a regional educational holding being an example. Its performance has been analyzed by using six criteria that evaluate the changes in the pedagogical innovation flow: rate, capacity, reference quality assessment, density, content variability, and uniformity. The data obtained have provided the evidence of practical efficiency of pedagogical innovation logistics.

Keywords: Pedagogical innovation logistics, methodological and practical aspects of pedagogical innovation logistics application, educational system, educational logistics, pedagogical logistics.

Introduction

Current global trends in education development are formed in response to the need to build a training system in such a way as to ensure the social success of each individual in the post-industrial society (Daniel, Bell, 1999; Martínez, 2019). There, a person is in demand as a “knowledge worker” who creates new products, i.e. information, services, solutions. Innovations become an independent social value and a priority for the educational system development. It is only possible to prepare a person for innovation production by his immersing in the educational environment, which alone exists and develops on the basis of innovations.

Creation of this environment involves understanding of the patterns and mechanisms of innovation management in education, a methodology relevant to a post-industrial society, based on which it is possible to develop

педагогической системы. Изменить сложившуюся ситуацию можно, интегрировав достижения образовательной и педагогической логистик, дополнив их идеей развития образовательной инфраструктуры и педагогической системы, которая в ней функционирует, в логистику педагогических инноваций. Такая логистика выступает как методологическая основа управления педагогическими нововведениями в образовании. Сферой применения такой логистики становится территориальный образовательный кластер, ее предметом – инфраструктурные, образовательные, интегративные потоки, поток помех и поток педагогических инноваций. В прикладном аспекте проверка эффективности логистики педагогических инноваций осуществлялась на примере регионального образовательного холдинга. Такая оценка выполнялась на основе шести критериев, отражающих изменения в потоке педагогических инноваций: в его мощности и скорости, в экспертной оценке качества и в плотности, в содержательной вариативности и в равномерности. Полученные данные позволили сделать вывод о практической эффективности логистики педагогических инноваций.

Ключевые слова: логистика педагогических инноваций, методологические и прикладные аспекты применения логистики педагогических инноваций, образовательная система, образовательная логистика, педагогическая логистика.

technologies for creating much-in-demand, competitive, and economically attractive innovations. We understand the latter as a purposeful, meaningful, definite change in pedagogical activity through the development and introduction of educational and managerial innovations in educational organizations.

Many researchers have noted that an individual organization may not have sufficient opportunities to create such innovations. To solve this task, several organizations at once need to combine their efforts and resources (Berezovsky, 2012; Petrov, 2014). The territorial educational clusters arising as a result of this merging strive to fully ensure the life cycle of innovations.

The mechanism to facilitate the way an innovation goes from an idea generation to its

implementation into a specific educational product and bringing it to a specific consumer is described by the term of “logistics”.

In the economic paradigm where it first appeared, this concept denotes scientific discipline, and, at the same time, the process and means of managing material, financial, information, service and other flows in the organization (Gadzhinsky, 2017; Golikov, 2006; Nerush, Yu.M., Nerush, A.Yu., 2014; Trofimova, 2012; Trofimova, 2014; Trofimova, 2017 et al.). The flow in this case is considered as a directed movement of any objects, as "a collection of objects perceived as a whole, existing as a process in a certain time interval, measured in absolute units for a certain period of time". The main parameters of the flow “are: origin and destination; trajectory and path length; intermediate points; velocity-time of movement” (Trofimova, 2012, p. 53; Trofimova, 2014, p. 85).

Covering "all types of process interactions" (Melnikov, Skhirtladze, Antonyuk, 2014, p.16) logistics "provides a methodology for optimizing flows of any nature" (Nosov, 2017, p.207). Focusing on “the rational building of processes and their relationships”, it “solves the issues of harmonizing aside from economic systems”. This adds to logistics "flexibility ... of its application in all management spheres of the society" (Melnikov, Skhirtladze, Antonyuk, 2014, p.16). Owing to this property, there is a possibility to transfer logistics as an economic category to the education sector.

Theoretical framework

The researchers' endeavor to realize this opportunity has led to the introduction of two new terms at once - educational and pedagogical logistics. Despite the existing ambiguity of their content and, possibly, synonymous use, these concepts identify mutually intersecting, but, nevertheless, different subject areas. Probably due to this, O.A. Trofimova (Trofimova, 2012, p. 52; Trofimova, 2014, p.85) draws our attention to the need of differentiating these two types of logistics, unfortunately without indication what their fundamental differences from each other are.

The phrase “educational logistics” became widespread after the publication of the study by V.A. Denisenko (Denisenko, 2003). Conceptually, this logistics is “a set of principles for optimizing processes in educational systems and structures” (Denisenko, 2003, p. 65).

Empirically, it is science and “the art of synthesizing scientific methods and techniques for studying ... mass educational flows ... to enable their point-to-point organization and management in order to achieve an effective increment in the social space and time of the personal culture vector of the flow-forming subjects of educational activity” (Gromova, Selivanov, 2012, p. 761-762; Denisenko, 2003).

In a narrow sense, the educational logistics as the science and technology of organizing and co-organizing educational functions (positions) and processes from the point of view of increasing the efficiency in general, is treated by Yu.V. Krupnov (Krupnov, 2018). In the context of school education, one of its tasks is to ensure continuity, i.e. finding a harmonious “combination of objects within the same parallel or programs and textbooks on one subject in different classes” (Krupnov, 2018; Trofimova, 2012, p. 52).

The areas of its application in higher education are also diverse. Thus, "in the context" of the preparation of competitive specialists at university, M.A. and N.A. Goncharovs see educational logistics as an “integrative management tool aimed at achieving the strategic, tactical, operational goals of organizing business education through effective (from the point of view of reducing overall costs and meeting the end-users requirements for the quality of educational services) human flow management, as well as its attendant material, financial, informational and other flows” (Goncharova, M.A., Goncharova, N.A., 2009, p.16). According to N.V. Shevchenko, the concept of educational logistics can form the basis for building a student’s career (Chuchkalova, Mosunova, 2013).

Regardless of the educational background, N.Yu. Sklyarova defines educational logistics as a science that studies “functioning of a large number of material and information flows that provide the learning environment and an educational process itself” (Sklyarova, 2012, p. 326). O.A. Trofimova supplements this definition as follows: “educational logistics ... is the science of the effective management of flow processes in an educational organization, based on the totality of the logistics principles of the educational system, for making an effective management decision “right on time”, “to the right place, in the right amount, of high quality, and at the lowest cost” (Trofimova, 2012, p.52; Trofimova, 2017, p. 39).

In its practical application, educational logistics is an “integrated process of planning, obtaining, accumulating, and moving educational services and information ... , which in turn is a methodological basis for analyzing the status of systems, searching, and adoption of sound management decisions”. It “is meant to ensure ... satisfaction of the needs of educational services consumers ... Its main task is to ensure the flow of knowledge, training, psychology, material and technical achievements from the supplier (educational institution) to the consumer (real economy)” (Sklyarova, 2012, p. 326).

Summarizing the above viewpoints, we can easily see that all of them consider logistics as a means that is external, not quite “incremented” to the educational (pedagogical) process itself. Awareness of the fact that “the pedagogical process ... is a specially organized interaction between teachers and pupils (pedagogical interaction) regarding the content of education using training and upbringing tools (pedagogical tools) in order to solve the problems of education aimed at meeting both the needs of the society and an individual in its development and self-development” (Slastenin, Isaev, Shiyanov, 2007, p. 85), remains at the periphery. An additional illustration of this is the names of the flows, which it is called upon to harmonize: a human (in terms of T. N. Skorobogatova - human (Skorobogatova, 2010)), information, material, financial and other flows. Obviously, today educational logistics is an economic tool adapted for educational marketing, financial management and general issues of managing the educational organization and its infrastructures, which mediate but do not determine the effectiveness and quality of pedagogical-scientific activity.

Probably in view of this, various authors note that “when working with educational processes, it is unacceptable to naturalize them and turn them into naturally occurring and ongoing “business processes” (as obtained within the frame of a generic analysis of business processes in production logistics). For this, it is necessary to work with the theory of educational activity and have a clear vision of the types of training and educational tasks, situations, generalizations, and all the transformations that must occur during educational processes” (Gromova, Selivanov, 2012; Krupnov, 2018).

In our opinion, pedagogical logistics meets this requirement to a greater extent, where the content framework is set not so much by the economy and management of the educational organization as the pedagogical system being implemented.

Introduction of a “pedagogical logistics” category is associated with the studies of V.M. Livshits, an Estonian psychologist. In his works, followed by other researchers (Andrjushkova, Legan, Jatsevich, 2011; Gromova, Selivanov, 2012; Denisenko, 2003; Trofimova, 2017; Shirochenko, Gromova, Kovaleva, 2013, etc.) he (Livshits, 2018; Livshits, 2007) considers pedagogical logistics as a science that studies “planning, organization, management, and control of pedagogical flows to ensure their system integration and optimization at a given quality of the educational process” (Nosov, 2017, p. 209). In other words, this is science, “which is engaged in the management (control) of pedagogical flows, based on the principles of logistics ... and simplicity of real systems introduced by Eliyahu M. Goldratt” (Gromova, Selivanov, 2012, p. 761-762; Trofimova, 2012, p. 52). The names and contents of these flows are noticeably different from those used by educational logistics.

Thus, V.M. Livshits provides a detailed description of these six flows. The flow of such a “fast-spoiling product” as knowledge is characterized by the rate of their production, improvement, transfer and aging (removal of obsolete knowledge). A psychological flow is associated with the solution of the problems of children upbringing and developing through adequate targeted actions carried out according to the “just in time” logistics principle. Formation of a Common Education Space, which prevents excessive competition between educational institutions, results from the training flow. The task of maintaining this space as an integrated system is solved by the information flow, which allows implementing network projects, providing personalized training, synchronizing the educational system with a job flow, etc. The health flow determines the duration of an individual’s intense activity as well as his/her ability to adapt, socialize and individualize, the possibility to realize their creative potential and even to make a vocational choice. Finally, the tool flow is aimed at acquiring various means required for the educational process. However, it is “a subject of economic (and not pedagogical — S.D.) logistics” (Livshits, 2018; Livshits, 2007) and is a supplementary one here.

Pedagogical logistics ideas have been further developed in A.L. Nosov’s studies. He allocates seven pedagogical flows assigned to three conventional groups. Thus, the necessary infrastructure and corresponding conditions for the implementation of the educational process

are created by the material and technical flow, representing one of these groups. The conceptual part of the pedagogical process is formed by means of training-educational and disciplinary-information flows. When overlapping, they "form a kind of supply chain of information and organizational components" for the flow of students; they are "dependent on other pedagogical flows and require special attention." All this is aligned with the third group of management flows: staffing, quality control, and strategic planning. The first one is controlled by the HR Policy and is associated with the attraction, development and relocation of specialists with the required level of professional training. The second one provides the subjects of the educational process with "continuous feedback" on its quality through "managerial monitoring of the pedagogical process quality, ... and test materials to monitor the students' expertise formed". The strategic planning flow covers strategic management of the educational institution activity: analysis of the internal and external environment of the pedagogical process, goals are formed and adjusted, relevant actions are planned" (Nosov, 2017, p.209).

On a practical level, these logistic chain forming flows (Vlasova, 2010, p. 270) are system-integrated, (Nosov, 2017, p. 209) with a middle course between them, due to which the pedagogical system is synchronized and optimized (Livshits, 2018; Livshits, 2007). This gives some authors reason to attribute pedagogical logistics to service logistics (Bulakhova, 2018) and, in addition, makes it a very promising means of influencing the educational process and events occurring in an organization. The latter is true when solving problems both related to training (Andrjushkova, Legan, Jatsevich, 2011; Bulakhova, 2018; Vlasova, 2010; Lopatukhina, Zalevskaya, 2014; Shevchenko, 2008, etc.) and education (Lopatukhina, Zalevskaya, 2014).

Our analysis has shown that the goal and objectives of educational logistics are related to ensuring educational institution infrastructure efficiency by lining up the flows, which influence its stable and successful functioning. This facilitates establishing necessary conditions to address educational issues: information, material, financial, personnel, etc.

Obviously, this does not seem enough to achieve pedagogical results, which encompass cognitive, personal and newly formed behavioral structures building in students and pupils as a result of pedagogical efforts. In a best-case scenario,

educational logistics makes it possible to create a friendly environment to implement these tasks.

Pedagogical logistics directly facilitates formation and development of children's competencies and skills, which, in our opinion, represents activities aimed at ensuring efficiency, i.e. sustainable and successful functioning of the pedagogical system. Towards this end, the flows are harmonized, providing conditions enough to achieve pedagogical goals associated with the training and education of the younger generation. However, with a prominent orientation towards the actual pedagogical realities, neither pedagogical nor educational logistics prioritizes the development of a system which harmonizes the flows. Even though this relation has been noted by various authors (Andrjushkova, Legan, Jatsevich, 2011, p.5; Grishchenko, Arkhipova, 2015, p. 97) in both cases, development of the educational infrastructure and the pedagogical system implemented on its basis are more likely to be implied than a conscious result of logistic actions.

We believe that it is possible to change the current situation through integration of educational and pedagogical logistics and supplementing them with the idea of developing the educational infrastructure and a pedagogical system to operate within. In this case, the scope of logistics includes various educational institutions or their associations (following I.D. Chechel, T.V. Potemkina (Chechel, Potemkina, 2012), and other authors, we consider them as educational systems), territorial educational clusters, and its mission is to ensure a flow of pedagogical innovation acting simultaneously as a creation and a factor in their development. It is possible to implement "logistics of logistics" only with a category that will act as a generic category for them and, thus, allows them to be integrated in a broader conceptual and methodological context.

As such category, we suggest using the "pedagogical innovation logistics" phrase, which designates the field of theoretical research and practical activity aimed at coordinating processes and flows in the educational system in order to create conditions sufficient to produce, test, and introduce educational innovations, as well as to promote the results in the educational environment.

It is this kind of logistics that we propose to consider on the one hand, as a methodological basis of innovations in the educational system, and on the other hand, as a way of practical

improvement of innovative activity, which can be described by the “pedagogical innovation logistics” phrase. Originating in the inner world of a specific innovator, this flow reaches its maximum when obtaining educational results from much-in-demand, competitive, and economically attractive educational innovation and ends with their promotion in the external and internal environment of the educational system.

Methodology

In our research were used the following theoretical methods: study of literary sources, synthesis, comparison, methods of logical generalizations (induction and deduction) that contribute to a theoretical analysis of the pedagogical innovation logistics issue as a methodology for innovation management in education.

The study is based on the results of the analysis of data on the qualitative and quantitative composition, scientific, methodological and social effectiveness of innovative activities of educational institutions of preschool, general, professional and additional education, which are regional innovation sites, as well as on the study of pedagogical innovations developed and implemented by them in educational practice.

The work used data obtained by us for 15 years (from 2003-2004 to 2017-2018 academic years). The term for the implementation of a particular educational platform of an innovative project could vary from three to seven years. At the end of each year of its operation, all sites provided for study and examination the results of their own innovative activities (innovative educational products), determined by the relevant terms of reference. Over the specified period, the number of sites in the educational holding changed annually and, in addition, many of them implemented two or more projects.

Due to these circumstances, information on the total number of sites involved in our study would be uninformative. For this reason, in the process of interpreting the obtained data, we took into account the minimum (66 innovative sites - in 2007), maximum (132 - in 2018) and the annual average (100 sites) the number of innovative institutions that are part of the regional educational holding.

Interaction with regional innovation platforms was carried out by us directly (as scientific leaders and consultants of their innovative activities) and indirectly (as members of the

expert council of the Ulyanovsk region on the formation and functioning of innovative infrastructure in the field of education).

Results and discusión

In our opinion, the pedagogical innovation flow refers to an independent field of logistics. Comprising all the educational system resources, it forms a special reality filled with both objective and valuable, and even ideological content subordinating all other processes.

The pedagogical innovation logistics is not limited to this flow only; it rather covers their entire set in the educational system. Elaboration of the flow content and assessment parameters, identification of factors that facilitate or impede the coherence between them are the tasks of independent research. We will just outline the flows that logistics operates with.

For this, we will apply a modification of the Blake Mouton Managerial Grid based on two behavioral dimensions: Concern for Result (tool orientation) and Concern for People: preservation and maintenance of favorable human relations (focus on relationships) (Michael, H. Mescon, Michael, Albert, Franklin, Khedouri, 2017, c.349-354). We will replace the original parameters with our own, adapted to solve the problem of compiling an approximate classification of flows being the subject of the pedagogical innovation logistics. The first parameter originates in educational logistics and reflects its orientation towards ensuring the functioning or development of infrastructure and non-pedagogical resources of the educational system. The second characterizes the same orientation but with respect to the pedagogical system (systems) realized within.

The space formed by these parameters comprises at least five types of flows: infrastructural, pedagogical, innovation, the flow of obstacles, and integrative flows.

Infrastructure (resource) flows. Material and technical, financial and economic flows are mandatory for any educational system. The elements and processes that form them are fundamentally focused on the infrastructure of the educational cluster, i.e. the resources and conditions that it has: premises, equipment, library funds, methodological support for the educational process, human resources, wages, etc.

With a low scale logistics orientation towards development, its main task will be to maintain the holding infrastructure in the condition critical to maintain existing innovation processes. If the development process comes to the forefront, logistics focuses on improvement of the cluster infrastructure and building opportunities that can be used for innovative activities. However, in both cases, pedagogical tasks as such are at the periphery of logistics interests.

Pedagogical flows. Vice-versa, in a mirror situation, the flows of training and education come to the forefront, which, when combined, form a more common flow of pedagogical processes. Its elements are educational ideology and the scope of education, methods, techniques, processes and technology, training and educating approaches, i.e. anything and everything that together forms a pedagogical system.

The functional orientation of logistics will be reduced here to reproducing the achieved pedagogical results, and the flow itself will have a uniform reproductive nature. In case when logistics is highly oriented towards the development of the pedagogical system, the flow is saturated with various components that create a favorable environment for innovative processes and various educational initiatives. At the same time, occurrence of fundamental pedagogical innovations requires a well-thought-out infrastructural and resource support.

The flow of obstacles (contradictions and conflicts). With the simultaneous prominent focus of logistics on the functioning of the educational organization and the pedagogical system, a paradoxical, at first glance, situation may arise, in which the flows that impede the achievement of logistic goals will originate. The main reason for their generation will be the lack of orientation of logistics towards development, due to which there will be contradictions and conflicts both within the infrastructure and pedagogical flows, and between them.

For example, despite their undoubted significance in the educational holding, the material-technical and financial-economic flows perform a service function with respect to the flows of training and education. From the perspective of the logistics of pedagogical innovations, the elements and processes of resource flows represent a means to achieve pedagogical goals and implement pedagogical innovations. Otherwise, the natural development of events will lead to a situation in which pedagogical innovations and goals will be

subject to the requirements of financial and material conditions. This state of things reflects the contradictions between different groups of flows in the cluster, which will act as one of the sources of obstacles to the cluster development. There will be no innovation flow at all, or it will become declarative. Originating initiatives and trends for innovations will encounter strong resistance manifesting itself in the inertia and absolutism of maintaining the achieved state of infrastructure and the pedagogical system.

It can be assumed that with the increase in functionally oriented logistic efforts to eliminate such obstacles, the latter will only increase. At some point, this may pose a threat to the activities and existence of the educational cluster.

Integrative flows. Result-oriented solving the problems caused by obstacles is possible through reorientation of logistics from the purposes of functioning towards the development purposes, as well as through regulation of integrative flows. This group combines several separate flows: an information flow and the flows of subjects of educational relations. Primarily based on psychological laws (communication, perception, individual characteristics, etc.), they have a projection into other flows determining their content and specificity, mediating the relation between them.

On the one hand, the *Information flow* is represented by a combination of information and material resources that ensure their vertical and horizontal movement inside the holding. On the other hand, it forms a system of non-formal and extra-formal relations, which channels are used for interpersonal communication. Obviously, the process and the results of this activity, and, therefore, the information transfer will be determined by the infrastructure and pedagogical tasks of the holding, but to a large extent by the personal characteristics of the subjects of educational relations.

This is the fundamental difference between an individual and other elements logistics operates with: in an educational cluster, people simultaneously act both as objects and subjects of logistics. In the latter capacity, they, while remaining a part of the flow of the subjects of educational relations, become an integral element of all other flows, i.e. resource, pedagogical, obstacles, and pedagogical innovation flows. For some entities, logistics turns to becoming one of the professional functions. Others spontaneously affect events and processes driven by their own ideas of "what

is correct", their individual event perception, personal goals and reasons, individual properties, etc. In some cases, with a pronounced orientation towards functioning, such "spontaneous logistics" generally leads to the appearance of additional obstacles. In other cases, usually when addressing developmental challenges, it can facilitate the innovation flow.

Pedagogical innovation (development) flow. When this happens, the educational holding generates a flow of pedagogical innovations, which is of the greatest interest to logistics. In particular, A.I. Shinkevich has indicated the flows of innovations as an independent phenomenon of educational clusters. In his opinion, logistics in the educational cluster "allows us to provide a more efficient exchange of scientific and technical information between structural divisions, ensures division of labor when implementing interdisciplinary R&D, the joint use of costly scientific and technological equipment, a high level of managerial decisions, the dynamic allocation of resources, and in the future, it will ensure integration of the value chain and the chain of knowledge creation" (Shinkevich, Kudryavtseva, 2013, p.322).

With a combination of logistics focus on infrastructure development and, at the same time, the pedagogical system, the flow of pedagogical innovations becomes the main in the life and development of the educational organization, or their amalgamation.

Consideration of five flows as a subject of pedagogical innovation logistics allows us to formulate its common goal. It consists in alignment of the educational cluster flows in such a way that a steady flow of pedagogical innovations is formed. It is this flow that will become one of the main factors in the effective activity and development of the educational system in the unity of its infrastructure (organizational, administrative, material, financial, information and other resources) and pedagogical (content, forms, methods, means, techniques, etc. of training and education) components. Moreover, the goal of logistics will somewhat vary depending on whether we are talking about it as a scientific discipline or a social practice.

In the first case, the goal is to identify the patterns and mechanisms of the pedagogical innovation flow in the educational system. In the second, where the pedagogical innovation logistics appears as a sphere of practical activity, the goal is to ensure the flow of pedagogical innovations

in the educational system by finding and applying methods and means that facilitate the development of its infrastructure and pedagogical content.

Achievement of these goals is associated with the solution of a whole range of tasks, from which we will single out the main ones. Initially, a clear definition of the logistics flows, understanding of their content and specific features is supposed. It is also necessary to make as complete a picture as possible of the reasons, laws, and mechanisms due to which these flows are formed and exist, as well as the factors, which influence the changes in their characteristics. Further, it is required to determine the methods and means of logistic influences on the flows. In their application, we will identify the "gaps" of logistic activities and define the ways to improve logistics. After the adjustment, it will be possible to determine the criteria for evaluating the effectiveness of logistics in general. Most likely, they will be formed on the basis of qualitative and quantitative characteristics of pedagogical innovations and indicators of the educational cluster development.

In its implementation, pedagogical innovation logistics is based on the principles common to any type of logistics, including educational and pedagogical: systematization, integration, scientificity, concreteness, constructivity and variability (Bulakhova, 2018, p. 8-10; Trofimova, 2017, p. 39). Being an educational problem-solving tool, it will have to consider pedagogical principles as well: natural conformity, cultural conformity, humanization, integrity, democratization, unity and consistency of actions of an educational institution and a student's lifestyle, professional practicability, and the system of polytechnical education (Stolyarenko, 2017, et al.).

Being implemented within a territorial amalgamation of educational organizations and its more sophisticated form – the regional educational cluster, the pedagogical innovation logistics will rely on the principles of its establishment and functioning: innovativeness, self-sufficiency, subsidiarity, regional zoning, interconnection and specialization of cluster members, consistency, synergism, flexibility and variability, sustainability, self-organization, integrity, openness, corporational nature, feedback, formation of a shared information space, etc. (Ivanova, 2011; Safin, Masalimova, Zyalayeva, Matukhin, 2014; Chuchkalova, Mosunova, 2013 et al.).

The issue of logistics techniques and methods in education remains open. It is only obvious that their diffusion from classical logistics (a cybernetic method, economic-mathematical analysis, an operations research method, a prognostic method, scenario analysis, etc.) to the education sphere involves adaptation to the specifics of the tasks being solved.

The conceptual framework and practical aspects of logistics in education are at the initial stage of their development now. The first approaches to its understanding as a scientific phenomenon and an element of the educational system are being implemented.

Our first-hand operational experience with pedagogical innovation logistics is related to the activities of the regional educational holding. This type of horizontal-integrated territorial educational cluster is an amalgamation of multilevel educational and other organizations under the authority of the Ministry of Education (or university) to create a region's common educational space (Maksimova, 2015; Maksimova, 2013; Navazova, 2005).

Education holdings are engaged in innovative activities in each constituent of the Russian Federation, including in the Ulyanovsk Oblast. They combine the interests of an educational organization and the territory persistently developing an educational and innovative potential of the region.

The educational holding company under consideration is represented by a regional innovation structure in the field of education of the Ulyanovsk Oblast, which has existed for over a quarter century in the format of the Program for the Development of Innovation Processes in Educational Organizations of the Ulyanovsk Oblast. Launched in 1992, today this program represents a sustainable regional infrastructure whose strategic goal is "to provide the environment for innovative development of the preschool, general, additional, primary and secondary vocational education system in the Ulyanovsk Oblast" (*Program of innovative processes development in preschool, comprehensive, professional educational organizations and organizations of additional education of the Ulyanovsk Oblast*, 2013, p. 6). Structurally, the holding is built of elements that can be combined into five blocks:

- 1) the subjects of the holding: The Ministry of Education and Science of the Ulyanovsk Oblast and the municipal

education management bodies; School for Advanced Studies, universities, regional innovation sites (regional experimental sites, regional scientific and methodological centers and internship platforms);

- 2) regulatory framework to support the holding constituents' innovation activities – an innovation activities development program and an organizational plan for its implementation, as well as provisions governing the activities of regional innovation platforms;
- 3) organizational and methodological framework to support the holding constituents' innovation activities – criteria and forms of expert evaluations of programs and innovation activity results, reference data;
- 4) educational and methodological framework to support the holding constituents' innovation activities – seminar programs for managers and deputies of regional innovation platforms, training courses for research teachers;
- 5) scientific and methodological framework to support the holding constituents' innovation activities – a set of open access publications and materials on the results of innovative work, organization and holding of applied research events.

An average of 100 educational organizations in the Ulyanovsk Oblast carry out their innovative work within the holding annually.

To evaluate the pedagogical innovation logistics efficiency, we propose to use a combination of six criteria. Each of them allows evaluating one of the three interconnected logistic strategies performances: quantity input, quality input, and diversification of pedagogical innovations.

Within the framework of the quantitative strategy, the logistics performance is determined by assessing changes in the pedagogical innovation flow rate and capacity. A flow capacity reflects annual changes in the innovative educational output by the holding. A flow rate is the amount of time (period) given to innovative platforms to create a turn-key innovative educational product.

With this information on components and quantities, scientific, methodological and social effectiveness of the holding constituents'

innovation activities, we have compared two periods in the development of the regional educational holding – with a minimum and a maximum number of innovative platforms (66 platforms in 2007; 132 platforms in 2018). This comparison result has demonstrated increase in the flow capacity by 2.25 times, and the flow rate by 1.66 times.

Two criteria were also used to assess the logistics performance within the framework of the strategy for boosting pedagogical innovation quality: a change in the expert assessment of the pedagogical innovation flow quality and density. For each of the compared periods, we determined the expert assessment average and recorded its variation. The flow density was determined by a part of regional innovation platforms working on complex (judging by experts) innovations. Comparison of indicators has revealed an increase in innovation quality by 9% and an increase in the flow density by 4.5% based on expert estimates.

Logistics performance in terms of diversification was determined by indicators that reflect changes in the flow content variability and uniformity. The content variability is determined by such an indicator as innovation activity directions over a twelve-year period ratio. The uniformity is associated with a number of platforms operating in each of the innovation areas. Using them, we have revealed an increase in the diversity of the pedagogical innovation flow – by 1.44 times under the first criterion, and by 2.3 times under the second criterion.

These figures indicate successful implementation of the main logistics strategies, which is evidenced by increase in quantity, improvement of quality and diversification enhancing, and pedagogical innovation logistics performance that has been carried out in the regional educational holding over the past years, in general.

Conclusion

Based on our theoretical analysis of the pedagogical innovation logistics as a methodology for managing innovations in education, we can draw the following conclusions:

1. Creation of much-in-demand, competitive and economically attractive educational products involves a consistent innovative activity based on logistics.

2. The use of logistics in the field of education has led to the emergence of two different and poorly aligned positions. One of them is educational logistics aimed at ensuring the educational institution infrastructure performance and creating the conditions required for solving educational issues. Educational results are an actual goal of pedagogical logistics that ensures stability and proper functioning of the pedagogical system. Differing in the content of the operated flows and the action goals, educational and pedagogical logistics show similarity in focusing on simulation (reproduction) rather than development of the system they are being implemented.
3. Introduction of the idea of development implies a reorientation of innovative activities through integration of educational and pedagogical logistics based on a cluster approach in education. For this, we introduce a new concept of "pedagogical innovation logistics." It refers to a theoretical research field and practical activities that are aimed at coordinating flows in order to create a proper environment in the educational system to facilitate a steady flow of pedagogical innovations covering production, testing, and the introduction of pedagogical innovations, as well as promotion of the attained results in the educational environment.
4. A holistic development of the educational system formed by a combination of infrastructure and pedagogical components is defined by the pedagogical innovation logistics methodology as the object of research and activity. Therefore, the subject of logistics will be the flows that are realized within it. They can be combined into five groups: 1) infrastructure (resource) flows: material-technical and financial-economic; 2) pedagogical flows: training and education; 3) pedagogical innovation (development) flow; 4) the flow of obstacles (contradictions and conflicts); 5) integrative flows: informational flow and flows of educational relations constituents. Alignment of these flows and formation of a steady flow of pedagogical innovations, which ensures

- development of an educational cluster, are the main goals of logistics.
5. The practical effectiveness of the pedagogical innovation logistics will be determined by progress in implementation of three interconnected logistic strategies (the areas of logistic actions) aimed at increasing the number, improving the quality and diversification of pedagogical innovations. Within the regional educational cluster, this will ensure the production of a vast number of diverse and high-quality pedagogical innovations.
 6. To determine pedagogical innovation logistics performance, we propose to use a combination of six criteria. Each of them allows evaluating one of the three interconnected logistic strategies performances: quantity input, quality input, and diversification of pedagogical innovations. Within the framework of the quantitative strategy, the logistics performance is determined by assessing changes in the pedagogical innovation flow rate and capacity. To assess logistics performance within the framework of the pedagogical innovation quality improvement strategy, the following criteria are used: changes in quality and density of the pedagogical innovation flow. In terms of diversification, logistics performance is determined with indicators that record changes in content variation and uniformity of the pedagogical innovation.

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