



## THE IMPACT OF PEDAGOGICAL INNOVATIONS ON THE DEVELOPMENT OF THE EDUCATIONAL ENVIRONMENT IN THE CONTEXT OF MODERN CHALLENGES

### EL IMPACTO DE LAS INNOVACIONES PEDAGÓGICAS EN EL DESARROLLO DEL ENTORNO EDUCATIVO EN EL CONTEXTO DE LOS DESAFÍOS MODERNOS

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#### ABSTRACT

The article theoretically substantiates the cluster approach in education as a methodological basis for the development of the education system. The content of the concept of "educational cluster" is revealed depending on the level of clustering. Pedagogical innovations are substantiated as an essential characteristic of educational clusters; the existing classifications are supplemented by the author's typology of pedagogical innovations based on the cluster approach in education. The concept of "logistics of pedagogical innovations" is defined as a mechanism for managing an educational holding, as well as an area of theoretical research and practical activities aimed at creating conditions sufficient for the production, testing, implementation of pedagogical innovations and promotion of the results obtained in the educational environment. Based on the cluster approach in education, the concept of logistics of pedagogical innovations has been developed in a set of system-forming ideas, categorical and conceptual apparatus, features and principles of its implementation in an educational holding. A conceptual model of logistics of pedagogical innovations has been formed, including its methodological foundations, types

and stages of logistics activities, the content of the main logistics strategies, in accordance with which to develop criteria for assessing the effectiveness of logistics. The problems of implementation, ideology and main directions of development of logistics of pedagogical innovations in the educational holding are revealed.

#### Keywords:

Pedagogical innovations, educational cluster, educational holding, management of an educational center.

#### RESUMEN

El artículo fundamenta teóricamente el enfoque de clústeres en educación como base metodológica para el desarrollo del sistema educativo. El contenido del concepto de «clúster educativo» se revela en función del nivel de agrupamiento. Las innovaciones pedagógicas se fundamentan como una característica esencial de los clústeres educativos; las clasificaciones existentes se complementan con la tipología de innovaciones pedagógicas del autor basada en el enfoque de clústeres en educación. El concepto de «logística de innovaciones pedagógicas» se



define como un mecanismo para la gestión de un centro educativo, así como un área de investigación teórica y actividades prácticas destinadas a crear las condiciones necesarias para la producción, experimentación e implementación de innovaciones pedagógicas y la promoción de los resultados obtenidos en el entorno educativo. Con base en el enfoque de clústeres en educación, el concepto de logística de innovaciones pedagógicas se ha desarrollado en un conjunto de ideas sistémicas, un aparato categórico y conceptual, y las características y principios de su implementación en un centro educativo. Se ha desarrollado un modelo conceptual de logística de innovaciones pedagógicas, que incluye sus fundamentos metodológicos, los tipos y etapas de las actividades logísticas, y el contenido de las principales estrategias logísticas, con base en el cual se desarrollan criterios para evaluar la efectividad de la logística. Se revelan los problemas de implementación, la ideología y las principales direcciones de desarrollo de la logística de innovaciones pedagógicas en el centro educativo.

#### Palabras clave:

Innovaciones pedagógicas, clúster educativo, centro educativo, gestión de un centro educativo

#### INTRODUCTION

The transition of society to a post-industrial form of social organization defines competition as a key characteristic of new relationships emerging between its subjects, while competitiveness is considered a personal quality that ensures social success. The formation of competitiveness is achieved through the creation and development of high-quality services rather than the production and processing of resources. In such a society, the demand is for the "knowledge worker" or "cognitariat," who realizes their intellectual potential to generate informational products and services. This naturally leads to corresponding changes in the preparation of individuals for life and professional activity.

Compared to the traditions and capabilities of an industrial society, the demands of a post-industrial formation are fundamentally novel. As they become modern priorities, they drive social progress based on innovations, which are regarded as a factor accelerating societal development and enabling its transition to the post-industrial level. Their significance takes on an independent value, embodied in concepts such as "innovative society," "innovation economy," and "national innovation system" (Pellini & Bredenberg, 2015; Shikalepo, 2020; Molnar, 2020).

Viewing innovation as a method of managing the development of any system encourages its emergence in all spheres of social life, including education. The breadth

and intensity of innovations are so profound that the modern paradigm of the national education system can be described as development through innovation. Innovations have become a crucial attribute of the education system and a key condition for individual competitive advantages and social success (Dziubenko et al., 2021; Ammar et al., 2024; Fang, 2024). This path necessitates a theoretical understanding of innovations in education, the formation of a methodology, and the determination of management strategies that are relevant to the characteristics and patterns of post-industrial society.

Addressing these challenges may involve turning to scientific foundations that define the forms and methods of practical activities. Although these may externally differ across various economic spheres, they are subject to common developmental patterns and operational mechanisms that can be effectively applied to solving educational problems. One such foundation today is the cluster approach, a scientific direction that integrates theory and practice in the development of the education system through the creation and management of educational clusters.

Currently, the terms "cluster approach in education" and "educational cluster" are widely used in the conceptual field of education. These terms originated from the borrowing of generic categories from economics. The application of these concepts occurs simultaneously in several semantic contexts, with differences determined by the qualitative characteristics, scale, and scope of influence of the entities forming the cluster. For example, the term "educational cluster" is used in meanings such as "educational competence," "educational program," "educational organization," and "association of social institutions" (Bray, 2007; Fuller, 2018).

For objects belonging to different contexts, hierarchical relationships are characteristic: competencies function as a part of an educational program, which, in turn, is an element of the life cycle of an educational organization. This organization can itself be a participant in an association of social institutions (Lunenburg & Ornstein, 2012). This structure allows us to discuss differences not only in terms of qualitative characteristics, scale, and influence of educational clusters but also from the perspective of clustering levels.

Clustering represents a managed process of creating and transforming clusters by integrating the resources of its constituent entities to achieve a synergistic effect. This effect manifests itself in the creation of innovations, which serve both as the outcome of activities and as a prerequisite for the development of the cluster. The contextual content of each of these levels defines specific frameworks

for understanding the essence of the cluster approach in education and differentiating innovations.

This factor causes significant difficulties in determining the methods and tools that enable effective influence on the development, testing, and promotion of pedagogical innovations. These innovations must meet the requirements of competitiveness, demand, and economic attractiveness. Their emergence requires systematic innovation activities, a high level of knowledge utilization, and the consolidation of efforts and resources from multiple educational actors.

The combination of these conditions is a distinguishing feature of an educational holding. This structure represents an association of educational and other organizations based on cooperation and horizontal integration under the guidance of educational authorities (or a university) to create a unified educational space.

## MATERIALS AND METHODS

The mechanisms for managing an educational holding and fostering pedagogical innovations within it have repeatedly attracted the attention of scholars. However, their functioning is mediated by the creation of conditions that facilitate the emergence of educational innovations. Direct management of pedagogical innovations within an educational holding becomes possible through the implementation of a mechanism that ensures their development path from creation to testing and promotion.

The mechanism governing the movement of innovations throughout their life cycle is described by the concept of "logistics," which refers to the theory and practice of managing resource flows within various systems. From a scientific perspective, logistics offers a methodology for such management. In its applied sense, it functions as a universal tool for harmonizing process interactions and managing flows (the directed movement of certain resources) within an organization.

The study of this mechanism in the education system has led to the formation of two distinct perspectives. The first defines educational logistics as addressing the task of maintaining the stability of the educational system's infrastructure, which may consist of an individual educational institution or an association of institutions. The second perspective relates to pedagogical logistics, which aims to ensure the effectiveness, efficiency, and quality of the educational process.

The issues of developing the pedagogical system and the educational organization in which it is implemented remain beyond the scope of these types of logistics. Considering this variable becomes possible through the integration of educational logistics and pedagogical logistics based on the cluster approach. The result of this integration is the logistics of pedagogical innovations, which ensures the

flow of pedagogical innovations that serve simultaneously as a product of activity and a driving factor in the development of educational clusters.

The presented studies indicate a strong interest among scholars in the potential of the cluster approach in education, the role of innovations in the activities of regional educational clusters, and the application of logistics as a management mechanism for educational holdings. However, despite the abundance of research, the logistics of pedagogical innovations based on the cluster approach in education has not received conceptual and empirical justification and, therefore, cannot be effectively applied in the activities of an educational holding. This is due to several contradictions between:

- The state's requirements for developing the education system through innovations and the lack of methodologies and management strategies for innovation activities that align with the characteristics and patterns of a post-industrial society;
- The actual use of cluster phenomenology in pedagogical research and practical activities and the insufficient development of the cluster approach in education;
- The high importance of effective functioning and development of regional innovation infrastructures in education, particularly within educational holdings, and the insufficient study of the factors that determine these processes;
- The education system's high demand for pedagogical innovations and the lack of justification regarding their nature and diversity within the framework of the cluster approach;
- The necessity of implementing logistics of pedagogical innovations as a management mechanism in educational holdings and the absence of a comprehensive scientific concept and conceptual model for such logistics.

The identified contradictions define the scientific problem of the study: What are the conceptual and empirical foundations of the logistics of pedagogical innovations within the implementation of the cluster approach?

**Objective of the Article:** To provide scientific justification and verification of the concept of logistics of pedagogical innovations based on the cluster approach within an educational holding.

**Object of the Article:** Pedagogical innovations as both a product of activity and a factor in the development of an educational holding.

**Subject of the Article:** The logistics of pedagogical innovations based on the cluster approach.

## Research Hypothesis

The hypothesis of the study is based on the assumption that the logistics of pedagogical innovations, as a relevant management mechanism for educational holdings in a post-industrial society, supported by conceptual foundations and empirical data, will allow for the resolution of the identified contradictions, provided that:

A theoretical justification of the cluster approach in education is developed;

The concept of "educational cluster" is clarified, along with clustering levels, which are structurally defined by educational competencies, educational programs, educational organizations, and territorial educational clusters (Johnson & Vincent, 2003);

Pedagogical innovations are substantiated as an essential characteristic of educational clusters, and their typology is developed based on the cluster approach in education;

The concept of "logistics of pedagogical innovations" is introduced and justified as a mechanism for managing the activities and development of regional educational holdings;

A conceptual framework is developed based on the cluster approach, providing a comprehensive understanding of the logistics of pedagogical innovations (Stevens, 2013);

A conceptual model is formulated, including:

Methodological foundations of pedagogical innovation logistics,

Logistical activities and strategies for implementation,

Effectiveness assessment criteria,

Challenges and directions for further development;

The concept of logistics of pedagogical innovations is verified through an empirical study of educational holding activities.

Research methods used to test the hypothesis and solve the problems:

- theoretical: study of economic and pedagogical literature on the problems of implementing the cluster approach in education; generalization of works in the field of pedagogical innovations; extrapolation of conclusions and interpretation of economic terminology in the context of pedagogical knowledge; study of concepts and experience of applying logistics in education; modeling of logistics of pedagogical innovations as a mechanism for managing an educational holding;
- empirical: document analysis; included observation of the activities of a regional educational holding; questionnaire survey of regional innovation sites to obtain information on the effectiveness of their innovative

activities; study of the innovative experience of participants in an educational holding; expert assessment method; conversation; pedagogical experiment; comparative analysis of empirical data and synthesis of the results obtained in the concept of logistics of pedagogical innovations; modeling of management of a regional educational holding.

The scientific novelty of the research results is as follows:

1. The theory of pedagogy has been introduced with the idea of a cluster approach in education as a methodological basis for scientific and practical activities that ensure progressive changes in the education system through the creation, operation and development of educational clusters.

2. The content of the concept of "educational cluster" is revealed, describing an educational system represented by a set of interconnected similar objects, within which the integration of their inherent resources occurs. The core basis of such integration is the fundamental goal of the educational cluster, which consists in relatively quick finding of innovative solutions that allow: a) to flexibly and promptly respond to the demands of society, the state, the education system, b) to ensure the quality of education and conditions for the harmonious development of the personality of the younger generation, c) to create resources for their own development and management. The meaning of the concept of "educational cluster" is clarified, acquiring substantive specificity depending on the context and levels of clustering.

3. The variants of definition of the concepts of "cluster approach in education" and "educational cluster" at different levels of clustering are proposed and substantiated: educational competencies, educational programs, educational institution and association of social institutions.

4. The meaning of pedagogical innovations as an essential characteristic of educational clusters is specified. Based on the cluster approach in education, the author's typology is proposed, which suggests dividing pedagogical innovations into four orders. "Simple" innovations of the first order are associated with the use of the content of individual semantic contexts of the category "educational cluster". Innovations of the second ("medium" in complexity) and subsequent orders ("complex") arise as a result of the integration of the content of two or more contexts.

5. The concept of "logistics of pedagogical innovations" is introduced into scientific circulation and substantiated, defined as a mechanism for managing an educational holding. In theoretical terms, it is represented by an area of research related to the identification of laws and patterns of intra-cluster processes and flows; in empirical terms - practical activities to create conditions sufficient for successful innovative activities of the educational cluster.



6. A concept of logistics of pedagogical innovations has been developed, formed by a set of provisions that reveal its system-forming ideas (the aggregate subject, integration and synergy), methodological approaches with the leading role of the cluster approach in education, a categorical and conceptual apparatus of logistics (object, subject, goal, tasks, types and stages of logistics activities, logistics strategies, criteria for assessing the effectiveness of logistics), features of implementation and principles (general for logistics, general pedagogical, clustering and territorial educational cluster) of logistics of pedagogical innovations.

7. A conceptual model of logistics of pedagogical innovations has been formed, including the following blocks: conceptual-methodological, logistics activity block, criteria-results, problematization block, paradigmatic.

8. The problems of implementing logistics of pedagogical innovations have been identified and characterized, both general (methodological, organizational-managerial, psychological) and specific to the regional educational holding (problems of the relationship between the subjects of the educational holding; problems of implementing scientific activity in the educational organization; priority of external motivation of innovative activity).

9. Based on the identified problems, the main directions of development of logistics of pedagogical innovations in the educational holding have been designated, corresponding to certain ideological paradigms: axiological, humanitarian, interaction, content, technological.

The theoretical significance of the research results lies in the fact that the developed range of conceptual provisions, tools, methods and conclusions determines the solution of a major pedagogical problem - a conceptual and empirical definition of the logistics of pedagogical innovations based on the cluster approach. 1. The work provides a theoretical justification for the cluster approach in education as a scientific direction associated with the search and implementation of opportunities for the development of the education system through activities to create and manage educational clusters. A concept has been formed according to which the cluster approach, depending on the subjects (developers and implementers of educational standards and programs, various subjects of educational relations, educational and other organizations) and objects (educational competencies, educational programs, educational organizations, unification of social institutions) of grouping, provides methodological grounds for the implementation of this activity at various levels of clustering, such as:

- combining individual competencies into integrated complexes that allow for the discovery of new

opportunities for achieving educational results and increasing the efficiency of managing this process;

- developing and implementing an educational program that ensures the achievement of the required educational results;
- interaction and integration of the activities of subjects of educational relations that allow for the effective implementation of educational programs and the achievement of the required results in educational organizations;
- creating, operating, and developing associations that include educational and other organizations directly interested in obtaining educational effects for the purpose of territorial development.

2. The paper clarifies the meaning of the concept of «educational cluster» as an educational system formed by components homogeneous by some characteristics (subjects and objects of clustering). The resource community of the cluster arising as a result of integration allows for intensive innovative activity that meets the goals of its own functioning and development, as well as industry demands. Depending on the substantive context and level of clustering, an educational cluster can be revealed as: 1) an integral set of competencies reflecting a system of requirements for educational results, the achievement of which is necessary for the successful implementation of any activity; 2) an educational program or its independent integral element (document, discipline, textbook, element of the methodological system, admission, etc.); 3) an organization carrying out educational activities in the entire set of subjects, resources, processes, events that characterize its internal state and relationships with the external environment; 4) an association of educational organizations with various institutions and social institutions.

The resources of pedagogy as a science are enriched by substantiating and introducing a new concept of «logistics of pedagogical innovations», defined as a mechanism for managing an educational holding and the corresponding activities to create conditions sufficient to ensure a sustainable flow of pedagogical innovations in a regional educational holding. A theoretically important result of the study is the development of a concept of logistics of pedagogical innovations based on a cluster approach, revealing its system-forming ideas (of a combined subject, integration and synergy), categorical and conceptual apparatus (object, subject, goal, tasks, types of logistics activities and their stages, logistics strategies, criteria for assessing the effectiveness of logistics), implementation features and principles (common for logistics, general pedagogical, clustering and territorial educational cluster).

A conceptual model of logistics of pedagogical innovations has been introduced into the theory of pedagogy, complementing the methodology of pedagogical

research in the field of management of innovation activities and development of regional innovation infrastructures in the education system. The content of the model is presented by: system-forming ideas, methodology of the cluster approach in education, categorical and conceptual apparatus, features of implementation and principles of logistics; description of types and stages of logistics activities; characteristics of logistics strategies, criteria for evaluating the effectiveness of logistics; description of a set of problems of implementation of logistics in a regional educational holding; ideology and main directions of development of logistics.

At the beginning of the research, the term “cluster” was used to denote groups of geographically adjacent interconnected companies and related organizations, characterized by common activities and complementarity. However, today an increasing number of authors adopt the formulation corresponding to a specific study, which actualizes the issue of cluster identification features.

Analysis of primary sources reveals differences in scientists’ understanding of the key features that define a cluster as a social system. Generalization of research results forms a holistic view of the properties of clusters. Universal properties are: homogeneity of cluster elements; mobility of their composition, structure and boundaries; combination of centripetal and centrifugal forces; infrastructure, community of resources. Specific properties include: geographical proximity, network organization, mutual complementarity, self-organization, competition and cooperation, innovative focus and activity, synergetic nature, creation of a joint innovative product.

From a theoretical standpoint, the cluster approach in education is a methodology of activity that is revealed in a set of features and principles of clustering. Features of clustering in education that have the nature of patterns can be described as follows: clustering is successful with active support of the initiative to create an educational cluster from potential cluster entities, including education authorities; clustering is constructive provided that common values arise and are recognized by the participants of the educational cluster; educational clusters that have arisen on the basis of the value unity of the constituent entities are distinguished by relationships of trust, collectivism, mutual assistance and moral well-being between their participants; clustering is productive in the formation of a resource community of the cluster, which allows for the prompt resolution of numerous problems arising in a constantly changing educational environment; the effectiveness of clustering as a process of creating and transforming educational clusters is determined by the achievement of synergistic effects manifested in the creation of pedagogical innovations that act as a resource of competitiveness and a condition for its development. The

starting point for the implementation of these patterns are the principles of clustering: systemicity, activity, efficiency, value unity, regional appropriateness, development and controllability.

From a practical point of view, the cluster approach in education is manifested in the creation and management of educational clusters. The concept of “educational cluster” means an educational system that has the entire set of the above-mentioned universal and specific properties of clusters. The activities of an educational cluster, based on the unity of values and community of resources of its participants, are aimed at finding innovative solutions that allow promptly responding to the educational needs of society, ensuring the quality of education and conditions sufficient for the development of the younger generation, creating resources for their own development and managing it.

The main goal of an educational cluster at any level of clustering is to achieve an innovative educational result (an aggregate innovative educational product), which is considered the main difference between an educational cluster and other associations of elements of the educational space.

Such a product is pedagogical innovations as a targeted, meaningful, specific change in pedagogical activity through the development and introduction of pedagogical and managerial innovations in educational institutions. This allows us to characterize innovations in the unity of three sides: subject, describing the substantive aspect of innovations, the innovation being developed, the innovative educational product; procedural, characterizing the dynamic aspect of innovations, described by the categories of “innovation processes” (the entire set of transformations associated with the creation of conditions for innovations) and “innovation activity” (productive activity to create something new, distinguished by awareness and consistency); result, associated with the consequences of innovations, which can be described by the phrase “innovative educational result” (achievement of the planned qualitative and quantitative characteristics of pedagogical innovations; determination of the compliance of the activity, its components and results with the criteria of innovation; educational effects caused by the dissemination of innovations). For a qualitative description of pedagogical innovations in line with the cluster approach, two criteria can be used – differentiation and integration of contexts that determine the meaning of the concept of “educational cluster” and the corresponding levels of clustering. Based on these criteria, the author’s typology of pedagogical innovations is proposed.

1. In relation to the study of the problem of logistics of pedagogical innovations, the cluster approach in education

is a methodological basis for the implementation of scientific and practical activities that ensure the development of the education system through the creation, operation and development of educational clusters. It is revealed through a set of characteristic features, principles and levels of clustering in education. The features of clustering in education, which have the nature of patterns, are reflected in the following provisions:

- clustering is successful with active support of the initiative to create an educational cluster from potential cluster entities, including education authorities (Gioffre, 2017);
- clustering is constructive provided that common values emerge and are recognized by the participants of the educational cluster;
- educational clusters that have arisen on the basis of the value unity of the constituent entities are distinguished by relationships of trust, collectivism, mutual assistance and moral well-being between their participants;
- clustering is productive in the formation of a resource community of the cluster, which allows for the prompt resolution of numerous problems arising in a constantly changing educational environment;
- the efficiency of clustering as a process of creating and transforming educational clusters is determined by achieving synergetic effects, manifested in the creation of pedagogical innovations, acting as a resource for competitiveness and a condition for their development.

Taking these features into account allows us to formulate the following principles of clustering in education: systematicity, value unity, controllability, activity, efficiency, regional appropriateness and development.

Depending on the qualitative characteristics, scale and boundaries of influence of the grouped objects, clustering can be carried out at four levels: educational competencies, educational programs, educational organizations, associations of social institutions.

The key category of the cluster approach in education is the concept of “educational cluster”. Representing an educational system with a resource community of its forming elements, the educational cluster is aimed at the prompt search for innovative solutions to various problems arising both within the cluster itself and in the external educational environment.

The meaning of the concept of “educational cluster” acquires substantive specificity depending on the level of clustering. At the first of them, the cluster is revealed as an integral complex of competencies reflecting the system of requirements for educational results. In this context, the concept is used by such subjects of clustering

as developers of educational standards and educational programs, researchers studying the content and structure of competencies.

The second level of clustering is represented by the educational program or its independent integral elements (documents, disciplines, textbooks, elements of the methodological system, techniques, etc.), which are interconnected with each other and consolidate the interaction of norms reflected in competencies. In this sense, the concept of “educational cluster” is used by developers and “implementers” of educational programs: managers and specialists of organizations carrying out educational activities, teachers, and lecturers.

The third level of clustering corresponds to an educational organization in the entire set of subjects, processes, events characterizing its internal state and relationships with the external environment. A cluster emerges as a new systemic quality of an organization, a form integrating various connections that are built between educational programs during their implementation in the conditions of one institution. The objects of such an educational cluster are various institutions and their resources, and the subjects are the heads and employees of educational institutions, students and their parents, social partners (Bezzina, 2006; Batagan et al., 2011). At the fourth level of clustering, the connections that arise as a result of multifaceted relationships between organizations form a qualitatively new societal form characteristic of an educational cluster as a territorial association of social institutions. Here, all cluster participants can act simultaneously as subjects and objects of clustering: educational organizations in various combinations with government bodies, enterprises, business communities and other social institutions.

4. Logistics of pedagogical innovations is defined as a mechanism for managing an educational holding, as well as an area of theoretical research and practical activities aimed at coordinating intra-cluster flows in order to create conditions sufficient for the production, testing, implementation of pedagogical innovations and promotion of the results obtained in the educational environment (Porter & Ketelhohn, 2009; Aipinge, 2015). Using parameters that characterize the orientation of logistics toward the functioning or development of the infrastructure of an educational holding or its pedagogical system, we can identify the following flows. Infrastructure (material, technical, financial and economic) flows are focused on the infrastructure of an educational holding. Pedagogical flows (training and education) determine the features of its pedagogical system. Orientation of logistics toward the functioning of both the infrastructure and the pedagogical system of a holding will lead to an increase in the flow of interference (contradictions and conflicts)

in it, the elimination and prevention of which is possible thanks to integrative flows (information flow and flows of subjects of educational relations). The focus of logistics on the development of both the infrastructure and the pedagogical system of the educational holding facilitates the emergence of a flow of pedagogical innovations.

5. The system-forming ideas of the concept of logistics of pedagogical innovations based on the cluster approach are the ideas of a collective subject, integration and synergy. According to them, the educational holding is a collective subject formed and functioning on the basis of common values in the course of controlled and targeted interaction of its constituent participants. In the process of this interaction, they integrate their resources to achieve synergistic effects, manifested in the creation of pedagogical innovations that have become the result of activities and a factor determining the effectiveness of cluster management and its development. The implementation of these ideas is mediated by the features of the logistics of pedagogical innovations:

- logistics is productive when it is aimed at the development of a regional educational holding, using for this purpose all its resources as a system of interconnected infrastructural and pedagogical components; – the effectiveness of logistics is determined by the activity and competence of its subjects – participants of the educational holding engaged in logistics;
- logistics is optimal in the totality of types and stages of logistics activities, combining means and methods of implementing processes and procedural issues related to the organization of innovations at the level of a separate innovation site and the holding as a whole;
- the sustainability of the flow of pedagogical innovations is due to the focus of logistics on the development of both the infrastructure and the pedagogical system of the educational cluster, the coverage of logistics of all flows in the educational cluster;
- the effectiveness of logistics is determined by the success of the implementation of logistics strategies aimed at increasing the quantity, improving the quality and diversifying pedagogical innovations in the educational holding. The categorical and conceptual apparatus of logistics of pedagogical innovations reveals its goal (integrated development of the educational holding) and tasks, object (flows in the holding) and subject (coordination of flows), characteristics of the stages and types of logistics activities (forecasting, organizational and expert), logistics strategies (increasing the quantity, improving the quality and diversification of pedagogical innovations) and criteria for assessing the effectiveness of logistics (qualitative and quantitative characteristics of the flow of pedagogical innovations).

The principles of logistics of pedagogical innovations are combined into four groups: 1) general for any type of logistics (systematicity, complexity, scientific nature, concreteness, constructiveness, reliability, variability, efficiency, flexibility, integrity, preventiveness), 2) general pedagogical (conformity to nature, cultural conformity, humanization, integrity, democratization, unity and consistency of the actions of the educational institution and the student's way of life), 3) clustering (systematicity, value unity, controllability, activity, efficiency, regional conformity and development) and 4) territorial educational cluster (innovation, autonomy, subsidiarity, regional zoning, interconnection and specialization of cluster participants, systematicity, synergy, flexibility and variability, sustainability, self-organization, integrity, openness, interaction, corporatism, feedback, formation of a single information space). 6. The conceptual model of logistics of pedagogical innovations is presented by the following blocks: conceptual and methodological (contains system-forming ideas, methodological approaches with the leading role of the cluster approach in education, categorical and conceptual apparatus, implementation features and principles of logistics), logistics activities (describes prognostic, organizational and expert activities in the implementation of logistics), criteria and results (contains logistics strategies and criteria for assessing the effectiveness of logistics), a problematization block (reflects the problems of implementing logistics in an educational holding), paradigmatic (contains paradigms that form the ideology and directions of logistics development in the holding).

In an educational holding, logistics of pedagogical innovations ensures an increase in the quantity, improvement of the quality and diversification of pedagogical innovations. The success of these strategies is determined by the criteria for assessing the effectiveness of logistics:

- a change in the capacity of the flow of pedagogical innovations, defined as the ratio of the average value of the coefficient of amplification of the flow of pedagogical innovations to the coefficient of increase in the number of regional innovation sites within the selected time interval;
- change in the speed of the flow of pedagogical innovations, presented as the ratio of the time spent by the regional innovation platform on the creation of a finished innovative product in specific periods of time;
- change in the expert assessment of the quality of the flow of pedagogical innovations, measured as the ratio of the average expert assessments of the quality of the flow of pedagogical innovations in the current and previous periods;
- change in the density of the flow of pedagogical innovations (determined by the shares of holding participants working on innovations of different orders of



complexity), measured as the difference in the density of the flow in the current and previous periods;

- change in the content variability of the flow of pedagogical innovations, defined as the ratio of the number of directions to the number of directions in the previous period;
- change in the uniformity of the flow of pedagogical innovations, presented as the ratio of the index of uniformity of the flow of the current period to the similar index of the previous period.

Innovative activities are characterized by methodological, organizational, managerial and psychological problems. At the same time, the educational holding has specific problems at the macro- (lack of order for innovative activities and their support from educational authorities, their utilitarian perception of innovative platforms), meso- (distortion of the conceptual apparatus, deviation from the requirements for organizing and conducting research; focusing on describing the experience of a specific institution) and micro-levels (priority of external motivation for innovative activities among teachers and heads of educational institutions, increased pragmatism, decreased quality of innovations).

The development of logistics of pedagogical innovations is carried out in several directions. The axiological paradigm determines the value attitude to innovations, innovative activities and logistics entities, the educational holding and its participants. The humanitarian paradigm emphasizes the role of a person as a logistics entity, the importance of his/her support and assistance through training, professional communities and consulting. The interaction paradigm involves the coordination of intra-cluster and inter-cluster interactions, the development of innovation transfer and external cooperation through joint projects. The content paradigm forms the research of intra-cluster flows as objects of scientific knowledge, their interpenetration and methods of managing them. The technological paradigm reflects the improvement of logistics mechanisms and tools, methods and means of assessing its effectiveness, regulatory support.

7. Verification of the concept of logistics of pedagogical innovations is ensured by: 1) a comprehensive assessment of the innovative activities of the educational holding, 2) an analysis of the distribution of pedagogical innovations of different types of complexity in the holding, 3) an assessment of the effectiveness of logistics in line with the implementation of its main strategies. The obtained results allow us to establish positive quantitative and territorial changes in the composition of the holding, to record growth in the aggregate indicators of scientific (publications, their number and level; dissertations defended and prepared for defense; grants and competitions in which educational institutions participated), methodological

(number of pedagogical innovations developed, tested and implemented in the educational process; number of teachers who took part in events held by innovation sites) and social performance of its participants, the presence of positive educational effects. The greatest development in the educational holding was received by innovative activities related to innovations of the first and second orders of complexity. At the same time, work is underway on innovations of a high degree of complexity (third and fourth orders), which require significant resources from innovation sites and preparation from subjects of innovative activities. Comparison of the indicators of the flow of pedagogical innovations, indicating changes in its capacity and speed, density and expert assessment of quality, content variability and uniformity, allowed us to positively assess the effectiveness of the logistics of pedagogical innovations and strategies for its implementation in the educational holding.

The data obtained indicate the success of the logistics of pedagogical innovations and their consistency with the provisions of the concept, which confirms its authenticity and effectiveness.

## CONCLUSIONS

This article examines some theoretical and practical aspects of logistics of pedagogical innovations based on the cluster approach in education. Issues related to the study of the possibilities of practical application of the cluster approach in education and the typology of pedagogical innovations, means and methods of logistics in education developed on its basis; supplementation and clarification of logistics strategies, criteria for assessing the effectiveness of logistics; training of teachers and scientific leaders for innovative activities in the context of a regional educational holding, represent promising areas of scientific research.

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