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EDITORIAL

REVIEW ARTICLE

Developing an Educational, Pedagogical and Teaching Logistics System for the Higher Education Ecosystem

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A – Study design;
B – Data collection;
C – Statistical analysis;
D – Data interpretation;
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G – Funds collection

Abstract

Background and Aim of Study: *Contemporary realities are rapidly changing the education landscape. Developing scientific methodology, theory and technologies, including digitalisation and artificial intelligence, requires us to rethink the organisation of the educational process in terms of implementing a logistics system.*
The aim of the study: to substantiate the interconnection and mutual influence of educational, pedagogical and teaching logistics as elements of the logistics system, and to develop a model of the logistics system of developing the higher education ecosystem.

Material and Methods: *The present study employed a systems approach methodology and a complex of theoretical research methods. A modelling method was used to develop a model of the logistics system of developing the higher education ecosystem.*

Results: *The essence of the concepts of "educational logistics" and "pedagogical logistics" was clarified, and the concept of "teaching logistics" was introduced into scientific circulation. These concepts were considered for the first time as interconnected and interdependent elements of the logistics system with the possibility of integrating these elements into the higher education ecosystem. To develop the higher education ecosystem, a model of the logistics system containing educational, pedagogical and teaching logistics subsystems was created.*

Conclusions: *The developed model reflects the role of influence for resource flows in achieving the goals of the structural and functional components of the logistics system, as well as the place of stakeholders within this system and the possibilities of using artificial intelligence in each of the educational, pedagogical, and teaching logistics subsystems. Implementing a model of the logistics system of developing the higher education ecosystem will optimise and increase the efficiency of the educational process.*

Keywords: *educational logistics, pedagogical logistics, teaching logistics, interconnection and mutual influence of elements, logistics system model, higher education ecosystem*

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Introduction

Implementing a logistics system in universities significantly impacts the entire specialist training system. This logistics system enables increased efficiency and optimised operations by providing structured planning and supply chain management. This ensures that the diverse academic requirements of stakeholders are met.

This process is characterised by significant changes in pedagogical theory and practice, with the introduction of new approaches, categories and concepts.

The concepts of "pedagogical logistics", "educational logistics", "evolutionary pedagogical logistics", etc. are becoming increasingly widespread in modern scientific publications. These concepts have many formulations, depending on the characteristics on which authors base their understanding, and their vision for optimising the educational process. This situation leads to a misunderstanding of the essence of these concepts, with insignificant features being isolated and these concepts being used as synonyms.

Therefore, the current task is to distinguish between and clarify the essence of the concepts of "educational logistics", "pedagogical logistics" and "training logistics", and to determine how they are interconnected.

Analysis of contemporary scientific publications and research on educational logistics has revealed that this concept is not currently clearly defined or understood.

Educational logistics encompasses the processes, systems and information flows that facilitate the streamlining of education at universities of applied sciences, from educational development to certification. When educational institutions start to embrace flexibility and make different choices about how they organise education, this inevitably leads to changes in educational logistics (SURF, 2013b).

Skoroogatova (2010) argues that educational logistics is a branch of service logistics as a concept of managing human flows in all economic spheres, involving the management of flows of those who teach and those who learn.

According to Shevchenko (2008), educational logistics was defined as a set of principles for optimising processes within educational systems and structures.

The term "pedagogical logistics" is most commonly used in Eastern Europe.

Livshits (2007) used the terms "psychologised pedagogical logistics" and "evolutionary pedagogical logistics". In this case, evolutionary pedagogical logistics manages the flow of knowledge, evolutionary pedagogical psychology, evolutionary learning, evolutionary health, evolution, information and equipment.

Although the term "teaching logistics" appeared in English-language scientific publications (Carravilla & Oliveira, 2004), to date, only one specific definition has been introduced into scientific circulation, by Melnyk and Pypenko (2017b).

Issues related to the implementation of logistics systems in higher education were discussed in publications by Erturgut (2016) and Grala and Jałowiec (2024).

Waller et al. (2008) identified four key macro-environmental factors impacting the current state of logistics education: an increase in logistics education programmes, a limited supply of logistics-trained faculty, changes to content requirements and a changing teaching environment.

In collaboration with secondary schools in the Netherlands, research was conducted into new logistics methods to organise personalised learning. Bakir et al. (2011) argue that the data obtained in the course of logistics research can be applied in an educational context. School representatives emphasise the need for new, fundamental research into developing logistics models that prioritise people. The authors (SURF, 2013) developed a model of educational logistics through joint activities with educational institutions. They believe this model helps to make educational logistics more understandable and concrete. This model visualises the interrelationships between topics such as educational development, planning, certification and assessment. The educational logistics model enables teachers, service providers, policymakers and educational institution administrators to initiate discussions about the importance of educational logistics within their institutions, allowing them to capitalise on opportunities in this area.

Previous studies have examined the current state of digital education and learning in logistics, focusing on the integration of advanced technologies such as blockchain, virtual reality, digital twins and artificial intelligence (Abdillah & Wahyuilahi, 2025; Melnyk & Pypenko, 2020; Santhi & Muthuswamy, 2022).

Gonzalez-Mingot and Marin (2025) found that educational technology ecosystems could be employed to examine issues relating to the governance of public education and the key stakeholders in digital education. Smart logistics is changing the very concept of logistics management. Therefore, the efficiency of logistics operations in higher education can be improved by using information and communication technologies and artificial intelligence (Feng & Ye, 2021; Melnyk & Pypenko, 2025; Wang et al., 2019).

A study by Khistyeva and Pocsova (2024) examined logistics strategies that combine PUSH directive strategies, which focus on structured guidance, with PULL research methods, which focus on student initiative.

Lukman et al. (2021) analysed how sustainable development topics had been integrated into logistics-oriented curricula at European universities. In general, logistics study programmes across Europe do not offer enough flexibility to keep up with recent research and development trends, except at universities in the most developed and innovative European countries, such as Germany, Denmark and the Netherlands.

Recent findings show that the digitalisation of society as a whole, as well as the education systems being implemented in various countries, is of great importance for the development of the higher education ecosystem (Degen et al., 2025; Pypenko & Melnyk, 2021; Siyal, 2025; Xalxo et al., 2025).

The situation caused by COVID-19 has been found to have had a significant positive impact on the digitalisation of higher education and all its stakeholders (Komljenovic et al., 2025; Melnyk et al., 2022; Mifsud & Orucu, 2025).

Wu et al. (2025) have studied the use of artificial intelligence (AI) in the educational ecosystem for analysing stakeholder activities.

Nguyen (2025) examined how AI should be integrated into higher education, and which ethical and pedagogical principles should guide its use by educational stakeholders.

The study by Baig and Yadegaridehkordi (2025) examines how education stakeholders behave with regard to the ongoing use of GenAI systems in higher education, and evaluates their satisfaction with these systems.

An analysis of previous studies indicates that AI is becoming a revolutionary factor in the developing of higher education (Melnyk & Pypenko, 2024). Not only can AI improve learning outcomes, it can also improve the management of educational resources (Khan et al., 2025). This could help ensure the long-term sustainability of higher education.

Several studies have demonstrated the widespread use of AI in predicting and influencing students' academic performance (Johora et al., 2025; Merino-Campos, 2025).

Certain publications have largely indicated that training specialists at universities based on the implementation of logistics potential can not only improve the quality of education and prepare more competent specialists in the field of logistics, but also contribute to bringing university educational models into line with industry requirements (Drejeris et al., 2024; Liu, 2024; Melnyk & Pypenko, 2017a; 2020; Pacheco-Velazquez et al., 2025).

We believe that utilising the potential of stakeholders and incorporating AI into the logistics system will improve planning and management efficiency, thereby enhancing the synergistic effect.

Therefore, there is a need to substantiate a model of a logistics system for the development of the higher education ecosystem, in which stakeholders and AI should be represented in all elements of the logistics system.

Modern higher education institutions actively use AI-based models in their development and application (Aiwa & Hongwei, 2024). Using such models significantly increases students' interest in and engagement with learning, and contributes to their success.

Rodrigues et al. (2025) investigated the possibilities of modelling reduction scenarios and managing logistics costs in higher education institutions. They highlight the significant potential of these models when accounting for the variations that comprise the system.

Logistics models, such as logistics business process models, logistics system models, logistics flow models, logistics chain models and logistics regression models, are widely used in many different areas of human activity. However, at the present stage, the logistics model (logistics system model) in higher education has not yet been developed, substantiated, or empirically tested.

The aim of the study. To substantiate the interconnection and mutual influence of educational, pedagogical and teaching logistics as elements of the logistics system, and to develop a model of the logistics system of developing the higher education ecosystem.

Materials and Methods

The present study employed the systems approach methodology, as well as the following theoretical research methods: deduction and induction; analysis and synthesis; abstraction; comparison; generalisation; systematisation.

The modelling method was used to develop a model of the logistics system for the higher education ecosystem developing.

Results and Discussion

An analysis of scientific publications revealed that the term "pedagogical logistics" does not have an established definition. Furthermore, it has been replaced by other concepts, such as "educational logistics", "psychologised pedagogical logistics", "evolutionary pedagogical logistics", etc. We believe that some of these terms are more "high-ranking", and that others are derived from them. Additionally, these concepts are closely interrelated in terms of their characteristics, which scientists sometimes interpret based on the paradigms and concepts of their research. This caused considerable confusion regarding their essence, hindering their further categorisation.

As pedagogical logistics is emerging as an in-demand interdisciplinary field of study in various areas of education, it is important to distinguish and clarify the essence of these concepts.

The conceptual and terminological apparatus of pedagogical logistics as a scientific direction began to take shape at the beginning of the first decade of this century and is still being formed. Today, it is based on concepts borrowed from scientific fields such as pedagogy (education, pedagogical system, pedagogical technology, etc.), psychology (motivation, attitude, action, etc.), economics (logistics, marketing, etc.), and management (organisation, management, etc.).

The term "pedagogical logistics" consists of two term-elements, and, in terms of content, it should be broken down into several concepts. The main concepts of pedagogy are upbringing, teaching, developing and education.

The etymology of the word "pedagogy" has ancient Greek origins (paidos – child and iago – to lead, to educate).

The word "pedagogue" (paidagōgos – educator, mentor) means a person who has special training and is engaged in teaching and educational work; a teacher or lecturer.

The etymology of the word "logistics" also comes from ancient Greek (logos – mind; log – thinking; logo – to think, to reason; logismos – calculation, reflection, plan; logistea – the art of practical calculation), meaning "the art of reasoning, calculating".

Analysing the concepts of "pedagogy" and "logistics" enabled us to identify their essential features, based on which the concept of "pedagogical logistics" was clarified.

Pedagogical logistics is a branch of pedagogy that reveals tactics for taking into account the interaction of resources and the realisation of management models aimed at optimising and improving the effectiveness of the educational process.

In defining the essence of the concept of pedagogical logistics, we firstly considered the laws of logic in systematisation and secondly took into account "lexical" factors in unification.

The parameter of term formation (derivation) also becomes important when clarifying the concept. This is the ability to form concepts (terms) of subsequent levels, higher and lower in rank, from a concept (term) of the same rank and level.

So, we have identified the essential and non-essential features of the concept of pedagogical logistics. The essential generic feature is "a branch of pedagogy", the essential distinctive feature is "that reveals tactics for taking into account the interaction of resources and the realisation of management models", and the non-essential features are "aimed at optimising and improving the effectiveness of the educational process". The identified non-essential features of this concept open up prospects for researching numerous ways and conditions to optimise and improve the effectiveness of the educational process.

It should be noted that, unlike all existing definitions of pedagogical logistics, we are the first to consider this concept as interrelated and interdependent with educational and teaching logistics. Together, these three elements constitute the logistics system. This will enable these subsystems to be integrated into a more global higher education ecosystem.

We believe that the concept of "educational logistics" ranks higher than the concept of "pedagogical logistics". Following the above laws of logic in organising and constructing the concept, we will give it a definition.

Educational logistics is the field of education that determines the overall strategy for its purpose, forecasting and developing, its specific projecting and planning, predicting results, as well as setting standards that fit educational goals.

We believe that teaching logistics is a lower-ranking concept than pedagogical logistics. As this term had not been used in any publications prior to our study (Melnyk & Pypenko, 2017a), we will define it.

Teaching logistics is a method of organising teaching that reflects the process of mastering teaching material within a subject, topic or issue; requires special organisation for the content, forms and methods of teaching.

Examples of educational logistics include the concept of education, the educational system and educational technology.

Examples of pedagogical logistics include the model of personality-oriented teaching, modular or problem-based learning, etc.

Examples of teaching logistics include specific forms, methods and techniques for organising teaching to ensure the effective assimilation of curriculum material on a subject, topic or issue, such as: "Lesson – immersion in the culture of the era ...", "Seminar – theoretical conference", etc.

Figure 1 shows the interconnection and mutual influence of educational, pedagogical and academic logistics as elements of the logistics system for developing the higher education ecosystem.

Figure 1

The Interconnection and Mutual Influence of Educational, Pedagogical and Academic Logistics as Elements of the Logistics System

Note. The dotted lines represent the mutual influence of elements of the logistics system, which are interconnected and influence each other.

Therefore, educational logistics is the foundation for pedagogical and teaching logistics. Educational logistics determines the overall strategy for appointments, forecasts developments, provides designs and plans, predicts results and establishes educational standards. Pedagogical logistics reflects the educational and

management processes within an educational institution, combining the content, forms and means of each process. This allows it to be a link between educational standards and strategies, and the specific method that a teacher/lecturer uses in their teaching activities.

The concepts discussed and clarified above represent a synthesis of achievements in pedagogy, logistics, economics, marketing and other sciences generated by social and technical progress. The concepts we have presented should not be regarded as dogma. They are one of the options that require a creative approach, involving comparison with your own knowledge and experience.

After examining the various concepts of "educational logistics", "pedagogical logistics" and "teaching logistics", we have developed the following conceptual models to define them:

- "educational model";
- "psychological and pedagogical model";
- "biosocial model";
- "cybernetic model";
- "information model".

Research on this topic has enabled us to formulate theoretical and methodological requirements for implementing a logistics system of developing the higher education ecosystem:

- systematicity (the logistics of the higher education ecosystem should have all the characteristics of a system);
- logicality (interconnection and subordination of all its components);
- integrity (unity and interdependence of all its components);
- efficiency (the ratio of resources spent to results obtained);
- optimality (correspondence of tasks to conditions);
- manageability (the ability to manage results during implementation);
- reproducibility (the possibility of application by other entities).

In accordance with the clarifications made, and to substantiate the content and direction of resource flows within the higher education ecosystem, we will now consider the components of resources.

- *Information resources*: a combination of information (data) that comes to higher education institutions from the surrounding environment, accumulates in the internal environment, as well as the possibility of disseminating information about higher education institutions in society (media, information packages, etc.).
- *Financial resources*: the state of the assets and liquidity of institutions in the higher education ecosystem.
- *Human resources*: the qualifications and adaptability of academic and teaching staff at higher education institutions to the demands of society.
- *The resources of the organisational management structure:* the character and flexibility of the leadership of institutions in the higher education ecosystem, the speed of management influence.
- *Technical and technological resources:* educational opportunities and their characteristics within institutions of the higher education ecosystem, and the availability of equipment, technologies and scientific achievements.
- *Spatial resources*: the territory of institutions in the higher education ecosystem, the location of lecture halls, laboratories, libraries, and so on, as well as the possibility of expanding them.

In logistics, the following types of resource flow are distinguished:

- depending on the type of systems connected by the flow: horizontal and vertical;
- depending on the place of passage: external and internal;
- depending on the direction in relation to the logistics system: incoming and outgoing;
- depending on the type of information carrier: paper, electronic, mixed;
- depending on density: low-intensity, medium-intensity, high-intensity;
- depending on frequency: regular, operational, random, online, offline.

The flow of information resources may precede the flow of other resources (financial, technical, technological, labour, etc.), proceed simultaneously with them, or follow them.

At the same time, the information flow can be directed both in one direction with other resource flows and in the opposite (counter) direction:

- The advance information flow in the opposite (counter) direction usually contains information about the demand for higher education specialists in society.
- The advance information flow in the direct direction provides advance notice of available specialist training in a particular field.
- Information about the quantitative and qualitative parameters of the flow of financial, labour, technical, technological and other resources is transmitted directly alongside the flow of these resources.
- Following the flow of resources in the opposite (counter) direction, information may be shared about the number of applicants enrolled and young specialists graduating, in terms of quantity and/or quality.

In logistics systems, the flow of resources often runs ahead of or falls behind that of other resources. These flows also have a specific vector correspondence feature: they can be either unidirectional or multidirectional.

Due to the variety of elements involved, resource flows can be considered complex, interconnected systems.

The following parameters should be introduced into the resource flow system: time, space, quantity, quality, form and value.

The processes of transforming resource flows in response to changes in parameters such as space, time, form and properties can be considered the implementation of a set of logistical functions. Conversely, implementing logistics functions achieves the necessary transformation of resource flows in terms of their spatial, temporal, qualitative and other characteristics.

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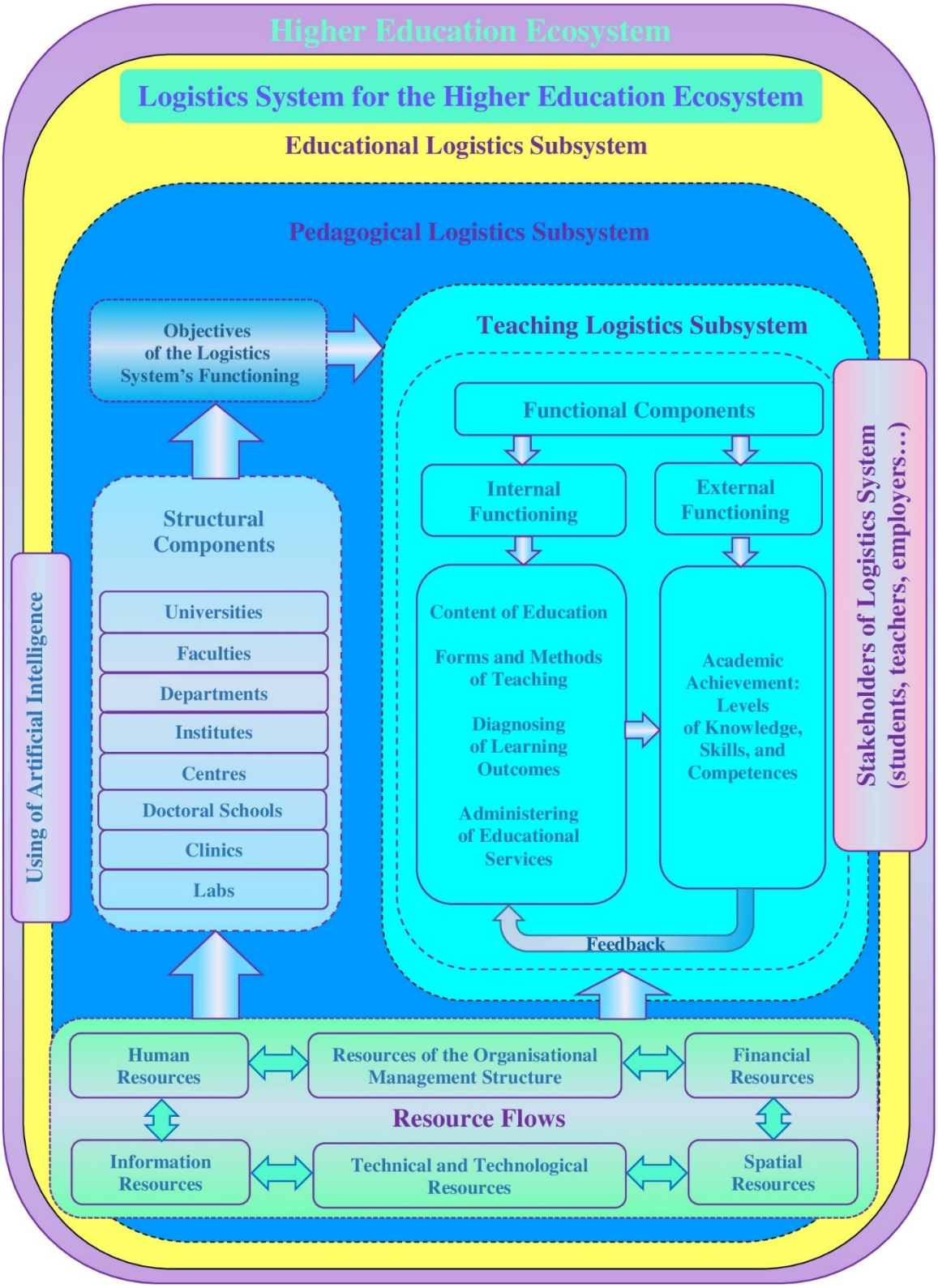
In order to comply with the principles of management and optimise resource flows within the subsystems of the logistics system, new methods and criteria must be developed to evaluate their performance. The degree of consistency between different flow processes largely determines the level of efficiency of the logistics system in the higher education ecosystem as a whole.

This allows us to develop a model of the logistics system of developing the higher education ecosystem (Figure 2).

Figure 2

A Model of the Logistics System of Developing the Higher Education Ecosystem



Taking a systems approach to substantiating the model of the logistics system of developing the higher education ecosystem has enabled us to identify three subsystems: educational logistics, pedagogical logistics, and teaching logistics.

Using a systems approach methodology to substantiate this model allowed us to identify the structural and functional components in these subsystems that are based on similar components of the model of higher educational ecosystem (Melnyk & Pypenko, 2025).

The pedagogical logistics subsystem is represented by structural components (universities, faculties, departments, institutes, centres, etc.). The entities of this subsystem have objectives that are implemented in the teaching logistics subsystem with the involvement of stakeholders.

The stakeholders in the logistics system of the higher education ecosystem may include students, teachers and employers (Melnyk et al., 2015; Pypenko et al., 2020).

The teaching logistics subsystem is represented by functional components, which are divided into two groups: internal functioning and external functioning.

The internal functioning components include educational content, teaching methods and forms, the assessment of learning outcomes and the administration of educational services.

External functioning components include academic achievements, such as levels of knowledge, skills, and competencies.

There are both direct and indirect (feedback) relationships between functional components. This makes the process more flexible and manageable, enabling you to achieve the intended outcome of operating the logistics system.

Using artificial intelligence can increase the effectiveness of implementing this model in practice.

The logistics system of developing the higher education ecosystem is significantly influenced by information resources, financial resources, human resources, spatial resources, technical and technological resources, and the organisational management structure (resource flows).

These resources are the basis and driving force for the implementation of a logistics system of developing the higher education ecosystem.

Conclusions

Based on the analysis of contemporary scientific publications and research on pedagogical logistics, the essence of the concepts of “educational logistics” and “pedagogical logistics” was clarified, and the concept of “teaching logistics” was introduced into scientific circulation. Unlike all existing studies to date, these concepts were considered for the first time as interconnected and interdependent elements of the logistics system with the possibility of integrating these elements into the higher education ecosystem.

The term “teaching logistics” was introduced into scientific circulation, and the essence of this concept was defined – a method of organising teaching that reflects the process of mastering teaching material within a subject, topic or issue; requires special organisation for the content, forms and methods of teaching.

The interconnection and mutual influence of educational, pedagogical and training logistics as elements of the logistics system were substantiated.

The following conceptual models were proposed to define these concepts: “educational model”, “psychological and pedagogical model”, “biosocial model”, “cybernetic model”, and “information model”. This opens up prospects for further theoretical and methodological research into numerous means and conditions for optimising and improving the effectiveness of the educational process.

Theoretical and methodological requirements for implementing a logistics system of developing the higher education ecosystem were formulated.

The composition of the logistics system's resource flow (including labour, information, organisational management structure, technical and technological resources, and spatial and financial resources) was established and characterised. The types and directions of resource flow were identified in order to optimise the use of all types of resource. This made it possible to substantiate a model of the logistics system of developing the higher education ecosystem.

The developed model includes subsystems of educational logistics, pedagogical logistics and teaching logistics. This model reflects the role of influence for resource flows in achieving the goals of the structural and functional components of the logistics system, as well as the place of stakeholders within this system and the possibilities of using artificial intelligence in each of the educational, pedagogical, and teaching logistics subsystems. Implementing a model of the logistics system of developing the higher education ecosystem will optimise and increase the efficiency of the educational process.

The present study does not cover all aspects of the issue of implementing a logistics system for the higher education ecosystem. Further research should focus on developing strategies and technologies to implement a logistics system across the various levels of the higher education ecosystem.

Ethical Approval

Research procedure used in the study is approved by the Committee on Ethics and Research Integrity of the Scientific Research Institute KRPOCH (protocol no. 026-3/SRIKRPOCH dated 10.08.2024).

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