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Adapting Big Data Technologies for the Governance of Philological Higher Education and Science: Navigating Uncertainty, Turbulence, and Systemic Risks

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Abstract. *The article explores the specifics and directions of adapting Big Data technologies in the management of philological education and science in conditions of uncertainty, turbulence and systemic risks. The features of philological data, the possibilities of their application for educational and scientific management, key risks and prospects for integrating Big Data with artificial intelligence, machine learning and NLP are identified.*

Keywords: *digital education; Big Data, philological education, philological science, education management, digitalization, predictive analytics, artificial intelligence, machine learning, NLP, uncertainty, turbulence, systemic risks.*

INTRODUCTION.

The modern system of education and science is developing in conditions of growing uncertainty, turbulence and systemic risks of the external environment [1], which significantly change the requirements for the management of educational and scientific processes. The philological sphere [2], which combines education, fundamental and applied research, language communication, translation studies, digital humanities and professional training of specialists, is especially sensitive to these changes. The increase in the volume of digital text, speech, multimedia and metadata creates an objective need for the use of new tools for their accumulation, processing, intellectual analysis and use for management purposes [3]. In these conditions, Big Data technologies become not only a tool for processing large amounts of information

[4], but also an important element of the transformation of the management of philological education and science [5]. The specificity of Big Data in the philological sphere is determined by the special nature of the relevant data [6]. Unlike structured data of traditional management, philological data are represented mainly by texts, corpora of language units, language materials, translations, digital libraries, research results, educational trajectories, communication flows and other weakly structured or unstructured arrays [7]. Therefore, the use of Big Data requires a combination of information, linguistic, statistical, pedagogical and managerial approaches [8].

The problem becomes particularly relevant in the dynamic external environment of modern pedagogy. Changing educational technologies, accelerating digitalization, the development of artificial intelligence, the transformation of professional competencies, the growth of distance and hybrid forms of learning, increasing information flows and the need for operational decision-making increase the need for intelligent adaptive management [9]. Big Data allows us to move from predominantly reactive management to proactive management, based on identifying patterns, forecasting trends and modeling possible development scenarios [10].

Therefore, the purpose of this article is to systematically substantiate the specifics, features, and directions of adapting Big Data technologies in the management of philological education and science in the conditions of uncertainty, turbulence, and systemic risks of the external environment of modern pedagogy.

RESULTS.

1. Specificity of Big Data in Philological Education and Science. Big Data technologies are a set of methods and tools for collecting, storing, processing, analyzing and visualizing large, diverse and dynamically changing data sets. In philological education and science, their specificity is determined mainly by the textual and semantically complex nature of information [11]: electronic corpora, scientific publications, educational materials, students' written works, digital libraries, translation databases, language corpora and data from educational platforms. Unlike traditional structured data, philological Big Data is characterized by a high proportion of weakly structured and unstructured information. Therefore, their effective use requires a combination of Big Data technologies with natural language processing, machine learning [12], artificial intelligence and methods of intelligent text analysis.

2. Big Data as a tool for managing philological education. In the management of philological education, Big Data can be applied at the strategic, tactical and operational levels. At the strategic level, they allow to analyze the demand for educational programs, predict changes in the labor market and determine the prospective competencies of specialists. At the tactical level, Big Data provides monitoring of the effectiveness of educational programs, student engagement and quality of education. At the operational level, they allow to analyze individual educational trajectories, task

performance results, typical errors and students' needs. Thus, a transition to data-driven management is taking place, in which management decisions are based on a systematic analysis of actual data, and not mainly on average scores and retrospective indicators.

3. *Big Data in the management of philological science.* In scientific activity, Big Data expands the possibilities of analyzing large arrays of texts, publications, bibliometric and scientometric data. Their application allows to identify research trends, thematic clusters, scientific connections and promising areas of research. For science management, this creates opportunities for a more informed determination of research priorities, assessment of project effectiveness, and monitoring of publication activity. Big Data is especially important for digital humanities, corpus and computational linguistics, translation studies, and applied philology, where big data simultaneously serves as an object of research and a tool for organizing scientific activity.

4. *Adaptation of Big Data to conditions of uncertainty and turbulence.* In an unstable external environment, simple implementation of Big Data is not enough; their adaptation to the conditions of functioning of changing educational and scientific systems is necessary. Such adaptation should be based on the principles of flexibility, contextuality, integration, sustainability, and human-centeredness. Flexibility implies the possibility of operational change of data sources and analytical models; contextuality - taking into account specific educational and institutional conditions; integration - combining Big Data with AI, machine learning, and educational analytics; stability - maintaining the system's performance in the face of external changes; human-centricity - using analytics as a tool to support, rather than replace, the professional activities of a teacher, scientist, and manager.

5. *Management model of Big Data adaptation.* It is advisable to organize Big Data adaptation as a closed management cycle: data collection → integration and structuring → intelligent analysis → interpretation → forecasting → management decision → monitoring → adjustment. Such a model provides constant feedback between data and management actions. In this case, the development of analytics from the descriptive level to the diagnostic, predictive and management levels is especially important. If the first levels allow us to understand the changes that have occurred and their causes, then predictive and attributive analytics make it possible to assess risks in advance and choose optimal management actions.

6. *Main risks and limitations.* The implementation of Big Data is accompanied by risks associated with data quality and fragmentation, incompatibility of information systems, lack of digital competencies, information load and dependence on digital infrastructure. Special attention is required to protect personal and educational data, information security and the ethics of algorithmic analysis. A significant limitation is also the risk of algorithmic reductionism, in which complex pedagogical and philological phenomena are reduced to quantitative indicators. Therefore, the most

rational is a hybrid model that combines automated processing of big data with professional expert interpretation.

7. Development prospects. A promising direction is the creation of intelligent management systems for philological education and science that integrate Big Data, artificial intelligence, machine learning, NLP and intelligent recommendation technologies. Such a combination creates the prerequisites for the development of adaptive management, capable of promptly responding to changes in the educational and scientific environment, predicting risks and personalizing management decisions. In the future, Big Data can become the basis for the formation of an intellectual ecosystem of philological education and science, focused not only on monitoring and control, but also on forecasting, optimization, personalization, and sustainable development.

CONCLUSIONS.

The conducted research makes it possible to identify Big Data as a promising technological foundation for the transformation of the management of philological education and science. Their specificity in the philological field is due mainly to the textual, semantic, loosely structured and dynamic nature of the data, which requires the integration of Big Data technologies with NLP, machine learning, artificial intelligence and methods of intellectual analysis.

In the management of philological education, Big Data create opportunities for strategic forecasting, monitoring educational trajectories, evaluating the effectiveness of educational programs and improving the validity of management decisions. In the management of philological science, they make it possible to analyze research trends, publication arrays, scientific connections and promising directions of development.

In the case of uncertainty, turbulence and systemic risks, it is not so much the use of Big Data as their adaptation to the dynamics of the environment that becomes important. Such adaptation should be based on the principles of flexibility, context, integration, sustainability, security and people-centeredness.

The most promising is a hybrid model of management that combines Big Data, artificial intelligence, intelligent analytics and professional expertise of teachers, scientists and managers. It is the combination of machine processing of large data sets and human interpretation that allows avoiding algorithmic reductionism and providing content-based decisions.

Thus, Big Data technologies are able to ensure the transition of the management of philological education and science from a predominantly reactive model to proactive, adaptive and intellectually oriented management. Their further development is related to the creation of integrated intellectual ecosystems capable of promptly detecting changes, predicting risks and opportunities, supporting the personalization of educational processes and ensuring the sustainable development of philological science and education in the conditions of a dynamic and uncertain external environment.

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