Analysis of Readiness of the Educational Environment for Effective Implementation of Artificial Intelligence in the General Education System of the Russian Federation

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Abstract

The authors briefly describe one of the stages of implementation of the federal project aimed at improving the effectiveness of teaching "Informatics" in secondary schools, taking into account the strategic objectives of the digital economy in terms of learning the basics of artificial intelligence. A new methodology is proposed for analyzing the readiness of the educational environment to effectively implement artificial intelligence in the general education system of the Russian Federation. The parameters that determine the versatility of the concept of "readiness" of the educational environment are considered. The article describes the "optimal" set of parameters and the directions of their analysis of the activities of educational organizations based on the experience of implementing artificial intelligence. A generalized work plan for implementing the project is given in the agreement with the customer - the Ministry of Education of the Russian Federation. The results of the project implementation can be used by the federal and regional executive authorities responsible for state administration in the field of education to achieve the key state benchmarks in the digital economy, as well as by the heads and teachers of general education organizations to improve the effectiveness of education and training in the basics of artificial intelligence.

Keywords

Artificial intelligence (AI), educational environment, digital economy, general education, analysis methodology

1. Introduction

Artificial intelligence is one of the fastest-growing sectors of the economy. The observed rapid development of AI technologies is accompanied by significant growth of both public and private investments in their development. Since 2017, there has been an international race for global leadership in AI. At that time, only five countries had a national strategy for AI development. Currently, more than thirty countries have already developed and are actively implementing their national strategies, including Russia, Canada, Singapore, China, Denmark, France, and many others.

The Russian government has identified the development of the digital economy and, in particular, AI as one of the main priorities of the government development policy. This is reflected in a number of key legislative acts:

- National Strategy for the Development of Information Society in the Russian Federation until 2030;
- The National Program "Digital Economy of the Russian Federation";
- National Strategy for the Development of Artificial Intelligence in the Russian Federation until 2030;
- Federal Law of 24.04.2020 N 123-FZ "On the experiment to establish special regulation to create the necessary conditions for the development and implementation of artificial intelligence technologies in the Russian Federation - the city of federal significance Moscow" [1];
- The concept of the development of relations' regulation in the field of artificial intelligence and robotics technologies until 2024 [2].

Per the Decree of the President of the Russian Federation "On the development of artificial intelligence in the Russian Federation" [3], a national strategy for the development of artificial intelligence was approved, which is based on a set of measures and technological solutions aimed at the development of intelligent information technologies that imitate human cognitive functions.

"Artificial intelligence is undoubtedly the basis of the next leap forward for all mankind in its development. These are the so-called end-to-end technologies that have and will continue to permeate all spheres of our life such as manufacture, social sphere, science and even culture becoming compatible with each other" [4], said the President of the Russian Federation V. V. Putin.

Artificial intelligence is penetrating all spheres of human life, assisting in opening up new horizons, e.g., in general and professional education [5]. Artificial Intelligence is one of the promising technologies allowing to harmonize the experience of students, teachers, and coaches in the educational process [6]. By 2030, the Ministry of Education of the Russian Federation is planning to implement the study of artificial intelligence in the school curriculum and prepare staff to organize the training system at all levels of schooling and professional retraining [7].

Approved in 2020, "Informatics" in organizations that implement basic general education programs, based on the content of school IT education, should include, among other things, information systems using artificial intelligence. Thus, it is necessary to provide methodological support for the implementation of training courses aimed at studying the basics of artificial intelligence systems, based on modern methodological approaches to the organization of learning activities in general education organizations [8, 9].

Development of a unified federal educational-methodical complex, including the educational program, educational-methodical materials for the program, methodological recommendations for teachers, will allow creating modern methodological conditions for the successful implementation of these courses and increase the effectiveness of teaching "Informatics" in general educational organizations.

By order of the Ministry of Education of the Russian Federation, Moscow Financial-Industrial University "Synergy" is implementing a project aimed at increasing the effectiveness of teaching "Informatics" in general educational organizations, taking into account the strategic guidelines of the digital economy in terms of learning the basics of artificial intelligence systems.

As part of the project: "Creation of modern educational and methodological support of the process of implementation in the general education system of training courses aimed at learning the basics of artificial intelligence" the following key activities are carried out:

- Analysis of the existing domestic and foreign practices of implemented training courses aimed at studying the foundations of artificial intelligence systems in the general educational system
- Expert sessions on ideas for the creation of concepts and structures of teaching-methodical complexes on realization in general education system focused on the bases of AI systems
- Development of the concept and structure of educational-methodical complexes for the implementation in the general education system of training courses aimed at studying the basics of AI systems
- Public and professional discussion of the developed concepts and structures of teaching-methodical complexes for implementation in the system of general education
- Creation of model educational-methodical complexes for implementation of courses in the general education system, aimed at studying the foundations of AI
- Launch of a pilot test of the created educational-methodical complexes for implementation in the general education system of training courses aimed at studying the basics of AI systems.

It is planned that the results of the project will be actively used by:

- heads and teachers of general educational organizations to improve the efficiency of education and training in the basics of AI [10]
- Federal and regional executive authorities that conduct state administration in education to achieve the key state benchmarks in the digital economy [11].

2. Methodology for analyzing the educational environment

2.1 Aims and objectives

The main goal of the analysis is to conduct an expert and professional assessment of the existing domestic and foreign practices of implementation of training courses aimed at learning the basics of AI in the general education system.

The main objectives of the analysis are:
1) to analyze the existing domestic and foreign practice of implementing training courses aimed at studying the basics of AI in the general educational system

2) to study the opinion of a Russian educational community concerning the experience of using the possibilities of AI in foreign countries in educational system
3) to evaluate the possibilities of using AI systems as applied to the tasks of developing and implementing a learning content
4) to identify the most significant areas of application of AI at different levels of school education and further education.

2.2 Methods of analysis

Based on the set goals and objectives, after analyzing the standard methods of data analysis used for this kind of tasks, the following methods were chosen:
- Content analysis of available textual, graphic, video, and audio information from open sources by expert groups to identify and interpret practices of implementation of training courses aimed at learning the basics of AI in the general education system
- Quantitative analysis (correlations, comparisons)
- Qualitative analysis (trends, connections, peculiarities)
- Expert evaluations.

2.3 Parameters of analysis

"Readiness" of the educational environment is a multifaceted characteristic, which can be evaluated by a range of parameters. To select the optimal set of parameters for analysis of the effective implementation of AI in general education, a series of expert meetings was organized with leading experts in the field of artificial intelligence and education.

As a result of these meetings six parameters were selected and their areas of analysis of educational organizations and their experience in the introduction of artificial intelligence.

The selected parameters are universal for any educational organization and take into account the diversity of existing forms of organizations and educational activities implemented by them.

Parameter 1: Experience in developing disciplines/courses on artificial intelligence in an educational organization of general education:
- Analysis of the availability of experience in developing disciplines/courses
- Analysis of the use of experience of domestic and foreign educational organizations
- Analysis of the intellectual property on educational-methodical support of disciplines/courses
- Analysis of the components of educational-methodical support of disciplines/courses
- Analysis of the difficulties encountered by the authors in the development of educational and methodical support disciplines/courses
- Analysis of the elements of teaching and methodological support of disciplines/courses that require revision
- Adaptation of the teaching and methodological support of disciplines/courses for students with special needs.

Parameter 2: Experience in implementing disciplines/courses on artificial intelligence in the educational organization of general education:
- Analysis of the experience in introducing the disciplines/courses
- Analysis of the experience in organizing the educational process to study the subjects/courses
- Analysis of staffing, which allowed the educational organization to successfully implement the disciplines/courses
- Analysis of the place of the disciplines/courses on AI in the curriculum of the educational organization
- Qualitative characteristics of constituent components of educational-methodical support of disciplines/courses
- Analysis of the effectiveness of the different ways to implement the disciplines/courses
- Analysis of the optimal ratios of the subjects of the disciplines/courses, their content, the age of students, and technologies for effective mastering of the educational material

- Analysis of the impact of the disciplines/courses on the issues of AI on the educational achievements of students
- Analysis of the availability of experience in the implementation of the disciplines/courses related to the issues of AI for students with special needs.

Parameter 3: Environments for the implementation of existing experience in the development and implementation of disciplines/courses related to the issues of artificial intelligence:
- Analysis of the computer equipment of the educational organization, ensuring the successful implementation of the disciplines/courses
- Analysis of classrooms of educational institutions, ensuring the successful implementation of the disciplines/courses
- Analysis of the information-library collection of the educational organization, ensuring the successful implementation of the disciplines/courses
- Analysis of educational services/platforms used by educational organizations to implement disciplines/courses
- Analysis of the list of programming languages that students learn based on the educational organization, contributing to the successful implementation of disciplines/courses
- Analysis of the partner organizations' material and technical resources used for the implementation of the disciplines/courses
- Analysis of the policies of educational organizations to familiarize employees with the regulatory framework related to the issues of artificial intelligence.

Parameter 4: Scalability of the existing experience in the development and implementation of disciplines/courses related to the issues of artificial intelligence:
- Analysis of readiness of educational organizations to disseminate the educational and methodological support and related developments in the implementation of disciplines/courses for employment in other educational organizations
- Analysis of the specific features of implementation of disciplines/courses of educational organizations, hindering mass dissemination of their experience
- Analysis of readiness of educational institutions to form on their basis the methodological associations on the introduction of artificial intelligence
- Analysis of partnership relations of educational organizations with universities, research centers, enterprises or companies, which employ specialists in the field of artificial intelligence
- Analysis of partners of educational organizations involved as consultants, experts, teachers for implementation of educational projects, connected with the artificial intelligence
- Analysis of the key difficulties encountered by educational organizations when introducing the disciplines/courses
- Analysis of the key advantages of implemented disciplines/courses.

Parameter 5: Experience of continuing education organizations in the professional development of educators in the theory and methodology of teaching artificial intelligence in the basic school:
- Analysis of the availability of experience in developing professional development courses for educators
- Analysis of the use of domestic and foreign experience in professional development courses for teachers
- Analysis of the experience in implementing courses for professional development of pedagogical workers
- Analysis of the assessment criteria of the level of competencies among the trainees of courses for professional development of pedagogical workers
- Analysis of the readiness of continuing education organizations to conduct mass training of pedagogical employees in the field of AI
- Analysis of the key advantages of professional development courses for educators, developed by continuing education organizations
- Analysis of the key difficulties encountered by continuing education organizations when introducing professional development courses for teachers.

Parameter 6: Introduction of foreign experience in the Russian system of general education:
- Analysis of the possibility of localization of foreign educational and methodological materials
- Comparative analysis of the principles of AI specialists' involvement in the educational process
- Analysis of the possibility of application in Russian educational organizations of the models of the educational process used in foreign educational organizations
- Analysis of the possibility of applying foreign practices of assessing educational achievements of students
- Analysis of the possibility of implementing foreign practices in the mass segment of educational achievement in Russia
- Analysis of the main shortcomings of foreign educational programs identified by education experts
- Analysis of public opinion in foreign countries on the study of artificial intelligence in the educational system.

2.4 Data sources for educational environment analysis

To increase the reliability and accuracy of the study, the following data sources were selected:
- Data available in open sources:
  - scholarly publications in print and electronic forms
  - websites of educational institutions
  - websites of educational authorities
  - websites of professional communities and associations of education specialists
  - websites of leading educational platforms for open education
  - websites of key federal and regional mass media
  - websites of developers, suppliers of systems, and providers of artificial intelligence services
- Data collected through questionnaires of educators, representatives of the management of educational organizations and continuing education institutions
- Data collected during personal interviews with leading specialists and experts.

3. Implementation of the educational environment analysis methodology

The research is scheduled for the period of February-May 2021.

The work plan for the project implementation was confirmed with the customer - the Ministry of Education of the Russian Federation.

The work plan includes:
1) Development of questionnaires for the survey of representatives of target audiences;
2) In-depth interviews with leading experts in the field of general and continuing education;
3) Creation of a dedicated project website. Placement of online questionnaires for the survey of target audiences on the created website;
4) Filling out online questionnaires on the project website by representatives of target audiences;
5) Formation of a database based on the completed online questionnaires;
6) Analysis of the collected data, using software for processing statistical information and business intelligence systems:
   - Classification by study factors (a set of data on different grounds for any data set),
   - Descriptive statistics for each data set (city, school, region, municipality, county, etc.) and selected parameters,
   - Graphic method to illustrate the results,
   - Content analysis of the questionnaire responses for the group of open-ended questions,
   - Data interpretation (explanation of the obtained results on request),
   - Pearson association coefficient for dichotomous variables to identify interrelated items.

Based on the results of the study, it is planned to develop the concept and structure of educational-methodical complexes for implementation in the general education system of training courses aimed at studying the basics of AI systems; to hold a public and professional discussion of the developed concepts and structures of educational-methodical complexes for implementation in the general education system and to create model educational-methodical complexes for implementation in the general education system of training courses aimed at studying the basics of AI systems.

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