DISTINCTIVE FEATURES OF ADAPTIVE LEARNING

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Annotation: this article proposes a methodology for developing flexible algorithms that provide an efficient, dynamic and personalized learning process for adaptive learning systems as a solution to exactly this problem. The article covers theoretical foundations, algorithmic solutions, as well as the possibilities of their integration into software platforms on a scientific basis.

Keywords: adaptive education, development methodology, algorithmic solutions, modern education, digital technology, individual need.

As a result of the rapid development of digital technologies in modern educational systems, the need for personality-oriented educational approaches, in particular adaptive educational systems, is significantly increasing. Unlike traditional educational models, adaptive systems allow for dynamic adaptation of educational content based on students ' level of knowledge, speed of acquisition, individual needs, and behavior in educational activities. The effective operation of such systems depends, first of all, on the accuracy, flexibility and learning of flexible algorithms that lie on their basis.

In recent years, there has been extensive scientific research into the creation of adaptive learning systems in the digital learning environment and their enrichment with algorithmic controls. The scientific developments carried out in this area are mainly based on machine learning techniques, big data analytics, student behavior models and technologies for automatic adaptation of study areas. B. In 1956. The idea of an individual learning approach pioneered by Bloom has served as a theoretical framework for modern adaptive systems. Later in 1998-2007, J. Brusilovsky is credited with proposing the mutual integration of user model, domain model, and adaptive strategies through his concept of web-based adaptive learning systems. This model identifies adaptive approaches based on content, interface, or navigation.

R. for the integration of machine learning tools into education. Nkambou, J. Bourdeau, Va. Methodologies outlined in "Intelligent Tutoring Systems" (2010), a collection edited by Miyake, envisage the algorithmization of critical functions such as predicting student cognitive status in teacher-free learning environments, knowledge gap detection, and automatic selection of educational resources. Also, D. Pardos and N. The Bayesian-knowledge observation model proposed by Heffernan justified itself as a flexible approach that updates the state of knowledge after each interactive action of the reader. In this model, individual tasks are recommended to the Reader using probability-based predictions. More recently, research using in-depth learning-based approaches, in particular Recurrent Neural Networks and Transformer models, has made it possible to study student acquisition dynamics in time. Such systems serve to make real-time recommendations and optimize content. We can also see in recent research published in international IEEE, Springer, and Elsevier that adaptive

systems show the development of recommendation mechanisms based on real-time analytics, user model updates, and competencies.

The rapid development of the digital education environment necessitates the creation of intellectual education systems that adapt to the individual needs of students. In order to meet this demand, the development of an adaptive training system based on artificial intelligence technologies requires a step-by-step approach.

First of all, at the stage of collecting information necessary for the system, the indicators of students ' behavior, interactive activities and mastering in the educational process are determined. At this stage, data on user traces (logs), test results and training activities are collected.

At the next stage, that is, in the process of pre-processing and ensuring confidentiality, the collected data is cleaned, structured and information security is guaranteed through blockchain and federated learning approaches. After that, it will proceed to the stage of development of the model of artificial intelligence. Here, on the basis of deep neural networks, the student's cognitive state is modeled, while reinforcement learning implements the content recommendation mechanism.

Biased elimination algorithms and real-time instructional alignment approaches are also integrated. Based on the model developed at the stage of the practical implementation of the Adaptive Training System, educational content and exercises are presented in a way that suits the needs of the student. In the process, the system is enriched with multimodal i.e. text, sound and visual components, and provides interdisciplinary alignment. System efficiency is analyzed at the assessment and optimization stage.

The participation of the student, the degree of preservation of knowledge and the quality of mastering are determined. The technical performance of the system is optimized on the basis of indicators of efficiency, level of accuracy and resource consumption. At the last stage – the introduction and expansion stage, the system is introduced on cloud or edge devices. At the same time, it is also possible to work in educational institutions with limited resources, which serves to extend the system to a wider audience.

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