ABSTRACT
dissertations for the degree of Doctor of Philosophy (PhD) in the educational program 8D06101 - "Information Systems (by industry)"

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DEVELOPMENT OF INFORMATION MODELS AND METHODS OF MULTICRITERIA FORMATION OF AN INDIVIDUAL TRAJECTORY OF DEVELOPMENT OF GIFTEDNESS OF STUDENTS

General characteristics of the work. The dissertation examines the issues of digital transformation of education and is devoted to the development of information models and methods of multi-criteria formation of an individual trajectory for the development of giftedness of students. At the state level, the emphasis is on the key tasks of introducing new modern teaching methods using information technologies. The traditional education model is gradually becoming obsolete due to the changing needs of the digital society and the influence of external factors. The educational system of Kazakhstan seeks to transform the outdated format of education towards a differentiated approach. Such pressing issues arise as the development of a digital educational environment in schools, the formation of students' digital skills, the creation of individual educational trajectories in the school digital environment, as well as the development of information technologies, models and algorithms that allow adapting curricula to the individual characteristics of students. Thus, the relevance of the dissertation is associated with solving the problem of developing information models and methods of multi-criteria formation of an individual trajectory with a focus on the development of giftedness of students, which allows improving the quality and effectiveness of the educational process in schools of the Republic of Kazakhstan. The object of the study is the process of implementation of the formation of an individualized learning trajectory with the support of information technologies.

The subject of the study is the models of formation of an individualized learning trajectory based on the use of modern information technologies.

The purpose of the study is to develop models and methods of multi-criteria differentiated learning with a focus on the development of digital competencies, which allows improving the quality and efficiency of the educational process in schools of the Republic of Kazakhstan.

Research objectives.

- to carry out an analytical comparison of the current methods of individualized learning and modern digital educational platforms;

- to develop models for assessing students' competencies in individualized learning, based on fuzzy logic methods and production rules;

- to develop an algorithm for forming an individual student's trajectory, mastering competencies based on individual indicators;

- to design the architecture of a differentiated learning support platform.

Research methods.

The scientific results of the dissertation were obtained based on the methods of decision theory, expert assessment methods, statistical information processing methods, the centroid method, the paired comparison matrix method and the fuzzy logic method.

Scientific novelty.

The scientific novelty of the dissertation research lies in the fact that a methodology for forming an individual giftedness development trajectory is proposed, taking into account several criteria, allowing for mastering the established competencies and taking into account the individual characteristics of students, using modern information technologies to support a differentiated learning format.

The main scientific provisions submitted for defense and possessing signs of scientific novelty:

1. Model for identifying the level of giftedness and differentiation of students based on the step-by-step application of several methods: centroids, consistency of paired comparison matrices and fuzzy logic;

2. Model for assessing students' competencies in individualized learning developed using fuzzy logic methods and production rules to support the differentiated learning format;

3. Algorithm for forming a multi-criterial individual trajectory of giftedness development, allowing to master the established competencies and taking into account the individual characteristics of the student;

4. Platform for supporting differentiated learning with an intelligent decision-making module for forming a learning trajectory.

Practical value of the research results. As a result of the research, an architectural solution was proposed, models and algorithms of information technology for supporting differentiated learning were developed, implemented in the form of an educational platform. The results obtained can be used as elements of an information system for the formation of an individual learning trajectory.

The research results are used in the network of Nazarbayev Intellectual Schools of the Republic of Kazakhstan.

Testing of work. The main results of the dissertation were presented and discussed at the following international conferences: IV International Scientific and Practical Conference of Students and Young Scientists (Kazakhstan, Ust-Kamenogorsk, 2020) [83]; Collection of articles of the international scientific and practical conference "Science of Higher Schools 2021". (Shymkent, 2021) [84]; Collection of proceedings of the All-Russian conference on mathematics with international participation. (Russia, Barnaul 2022) [72]; Journal of Theoretical and Applied Information Technology [86]; Journal of Theoretical and Applied Information Technology[85]; Bulletin of KarTU named after A. Saginov, section "Automation. Power engineering. ICT" [142,164]; Bulletin of VKTU named after D. Serikbaev, series "Information systems" [143, 165, 166].

Publications. On the topic of the dissertation, 10 scientific papers have been published, including 1 article in a journal included in the Scopus database (CiteScore

percentile equal to 57%), 5 articles in publications recommended by the authorized body of the Ministry of Higher Education of the Republic of Kazakhstan, 1 article in the scientific journal "MAK" (Russia), 3 - in the proceedings of international conferences (1 of which is in the Scopus database).

Structure and volume of the dissertation. The dissertation consists of an introduction, four sections, a conclusion, a list of references from 166 titles, set out on 130 pages of computer text, includes 50 figures, 13 tables.

The introduction substantiates the relevance of the research topic, object, subject, purpose, objectives and methods of research. The following are defined: scientific novelty, scientific provisions, practical value and implementation of the results of the work, data on publications and approbation of the work are provided.

The first section analyzes the current state of affairs in the implementation of differentiated learning in educational institutions. Differentiated learning is defined as an education model in which curricula, teaching methods and strategies are adapted to the individual needs, interests and socio-cultural context of each student. The choice of a specific type of individualization depends on: learning objectives, student characteristics and the availability of organizational and technical resources. The second section provides a methodology for using several methods: the centroid method, the paired comparison method and fuzzy logic methods to form an individual student trajectory based on personal competencies and a model for implementing differentiated learning. The model of differentiated learning based on fuzzy logic is considered, the intelligence maps of students are considered and an analysis is carried out using intelligence maps. The intelligence maps were processed using an adapted centroid method to assess the quality of knowledge. Also in the second section, the personal data of students on such a competency as IT skills was processed, for this purpose a base of 34 production rules was formed. As a result of several data processing, a methodology for multi-criteria comprehensive assessment of competencies was developed and student trajectories were formed, for this purpose the method of paired comparison matrix was used.

The third section of the dissertation is devoted to the development of an information platform, which includes a mechanism for automated data collection from various sources (student profile, mind maps, academic data on students). The student profile consists of two parts: basic and specialized. Based on numerous factors, a production model with input data was developed. The selected key characteristics for each type of competencies are accepted as necessary when creating individualized educational programs. The conducted research to determine the set of factors made it possible to develop an algorithm for forming a student profile model.

The fourth section of the dissertation proposes a concept for creating an information technology to support individualized (taking into account differentiation) education with an emphasis on revealing the potential of gifted students. The functional support for a multi-criteria educational platform for differentiated learning is described, which adapts to a variety of teaching methods and the individual needs of each student. The architecture of a multi-criteria educational platform for differentiated learning has been created and presented, as

well as program structures, conceptual and real models of data storage. The platform has been tested for several groups of students. The results of the testing have shown the effectiveness of using the proposed data processing method in organizing differentiated learning.

The final part of the dissertation presents a list of the main results and conclusions of the study, from which the provisions presented for defense follow. An assessment of the scientific originality and practical importance of the study is also carried out.