ABSTRACT

of the thesis work of **Utegenova Anar**
on the theme: «Models and methods of presentation and organization of a multi-level system of training educational resources specialists based ontology», submitted for a Ph.D. degree in the specialty 6D070400 - Computer technology and software.

The relevance of the research topic is:

- support of procedures of the government of the Republic of Kazakhstan on realization of the State Program on development of Science and Education for 2016-2019., and programs of digitalization of economic sectors;
- providing a new paradigm of information base of education that meets the needs of the digital economy, with an emphasis on the development of skills in information analysis and creative thinking;
- diversification of methods of e-pedagogy and range of educational services through the development of new educational, including Smart-technologies, in order to improve the efficiency and quality of education;
- in modernization of educational programs and plans of engineering personnel training, in order to develop the epistemological function of the competence approach;
- the need to apply methods of knowledge engineering and ontological engineering, as well as the introduction of information technologies and pedagogical means to intensify the learning and cognitive activity of students.

The purpose of the thesis is to develop an intellectual service and a model of knowledge representation and organization using competence and ontological approaches**;** the development of a methodology for designing disciplines and curricula of a multi-level system based on the project teaching method and concepts of the World CDIO Initiative

To achieve the goals of the thesis, the following **tasks** were set:

1. Research of methods of increase of efficiency of pedagogical and information technologies, on development of epistemological function of competence approach.
2. The study of empirical models of formalization and display of knowledge of the educational area, models of knowledge specification based on the ontological approach, technologies and tools of Smart-education.
3. Development of a methodology for the use of an ontological approach for designing ontologies of the educational content of disciplines and knowledge components of the planned learning of the educational environment.
4. Organization and presentation of knowledge models and the formation of knowledge components of the planned CDIO Syllabus training.
5. Development and justification of design and infrastructure solutions of the educational environment.

6. Experimental verification of the functioning effectiveness of the educational environment.

The object of the research are models, methods and software of educational resources.

The subject of study is the method of forming educational content based on ontology and the management of educational programs and processes.

Scientific novelty consists in the study of the structure of the formal presentation of data and the development of the syntax of the knowledge specification language for the deep modernization of educational programs in the field of technology, as well as modeling and design of methods of competence-based approach in the practical plane of project training of the Worldwide CDIO initiative, the method of foresight research and ontological engineering.

Interest in the study of educational problems has been reflected in numerous studies of Kazakhstan scientists: Mutanov G.M., Akhmetov B.S., Sadanov B.M., Sharipbaev A.A., Kubekov B.S., Yavorsky V.V .; scientists from near and far abroad: Gavrilov T.A., Tsukanov N.I., Subetto A.I., Khutorskoy A.V. Shmyrev N.A., Gubanov M.I., Kretsan Z.V., Elin E.G., Friesen M.A., Rubens N., Kaplan D., Okamoto T., Wheeler S., etc.

Research methods. In the thesis research the methods of ontological analysis of the educational field are applied; formal systems and procedures of knowledge output, network and algebraic models of knowledge display; concepts and mechanisms of generating and object-oriented programming.

The developed models and algorithms have been implemented in the form of a software system and implemented in the activities on the RSE for REU "Institute of Information and Computational Technologies" of the MES RK. The practical use of the results of the thesis has been supported by relevant documents.

The practical significance of the work: It is intended to disseminate the results and recommendations of the project in terms of changing the structure of educational programs and processes within the project on the theme «Models and methods of presentation and organization of a multi-level system of training educational resources specialists based ontology», the head is Candidate of Technical Sciences, Associate Professor of RSE for REU "Institute of Information and Computational Technologies"of the KN MES RK, Kubekov B.S. The results of the thesis are focused on the use in higher educational institutions for the optimal formation of curricula and programs.

The software product is a web-based application on the ASP.NET platform, which is focused on the individualization of learning paths in terms of preferences and individual abilities of students, preparing students for successful professional activities in a digital society and a smart economy. The thesis has an applied value,

provides information on the practical use of scientific results, confirmed by acts of implementation, with theoretical recommendations on the use of scientific findings.

Approbation of work. The main provisions of the thesis were reported, as well as discussed at the following scientific and technical and scientific-practical conferences: at the seminars of the Chair "Computer and Software Engineering" of the Kazakh National Research Technical University named after K. Satpaev; on the basis of the Project for the Integration of Science and Education, joint educational programs for the Master's and Doctoral Studies; in RGP PHV "Institute of Information and Computing Technologies" KN MES RK; in the teaching practice of the discipline "Software Engineering", for students of the graduate course of the specialty 5B070400 - Computer Science and Software, the "Academy of Cinema and Television" faculty of the University "Turan"; in the Schmalkalden University of Applied Sciences, Schmalkalden, Germany; International Scientific and Practical Conference Application of the conceptual model of knowledge for the formalization of concepts of educational content. 9th International Conference on Application of Information and Communication Technologies -AICT2015, (Rostov-on-Don), Russia, 2015; at the International Scientific and Technical Conference Development of an intelligent system to support management decision-making in education, Conference: 6th International Conference on Modeling, Simulation, and Applied Optimization (ICMSAO), Istanbul, Turkey; at the XII International Asian School-Seminar "Problems of optimization of complex systems", Novosibirsk, Russian Federation, 2016; at the XV All-Russian Conference "Teaching Information Technologies in the Russian Federation", 2017, Arkhangelsk, Northern (Arctic) Federal University; at the International Scientific and Practical Conference "Informatization of Education: Trends, Prospects, Innovations" (ITO-CFI 2015), 2015. Alushta, Republic of Crimea; at the V International Scientific and Practical Conference, "Intellectual Systems in Transport" (IntellectTrans-2015), St. Petersburg;- International Scientific and Practical Conference "Innovative technologies in science, Vol. I (2015, Dubai, UAE)"; at the Conference "Modern Problems of Informatics and Computational Technologies", IICT, CS, MES RK. 2018, Almaty; at the scientific conference “Problems of Optimization of Complex Systems” - Cholpon-Ata: IICT MES RK.2018; at the XVI Open All-Russian Conference "Teaching Information Technologies in the Russian Federation" MSTU n.a. N.E.Bauman-Moscow, 2018; at the IEEE 12th International Conference on the Application of Information and Communication Technologies, Almaty.- 2018.

Publications. The main provisions of the thesis have been published in 21 scientific papers, 5 of which have been published in journals indexed in the Scopus database; 3 articles have been published in publications recommended by the Committee on the Control of Education and Science of the MES RK; 11 articles have published in the materials of international conferences.

The structure and scope of the thesis. The dissertation consists of 134 pages of printed text, introduction, five sections and conclusion; includes 2 tables, 82 figures and a list oof references from 76 titles.

In the introduction, the relevance is revealed, the problems associated with the topic under study are specified. The idea of the work, the purpose and objectives of the research, the scientific novelty and practical value of the work, the research methods are given.

The first section presents the concepts of knowledge engineering, theoretical foundations of knowledge formalization, the use of ontological engineering in the representation and organization of semantic knowledge of the subject area; the use of paradigms of object and generating programming, as well as the basic principles of domain engineering associated with the creation of abstract representations.The language structures, the knowledge specification language created for these purposes, and their application in the context of analyzing the generality and variability of the concepts of the subject domain are shown.

In the second section, the methodology of the formation of educational (knowledge) components of the planned training, the CDIO Syllabus, is substantiated. The analysis of approaches to the classification of competencies of a specialist in the form of representation of the “tree” and “graph” of competences is presented

The third section describes the project part and the tasks of an adaptive educational environment developed in the framework of the study. The basic concepts and mechanisms of the adaptive educational environment aimed at the construction and use of reusable components, which act as educational (knowledge) components, as a result of ontological engineering of the subject area.

The fourth section provides design solutions for creating microservice, the specification of which is performed using diagram techniques and notation of the object modeling language UML. The search engine artifacts are described: diagrams of use cases, consistency, suitability, objects, components, deployment, and classes tat are required to design and develop search engines, technology platform which is based on a micro-service architecture.

The fifth section provides guidance on the use of an adaptive educational environment.The results of the experiment showed that the presented cloud services cannot provide the necessary quality of identifying the knowledge concepts required for the formation of ontologies, which makes the development of the program for the automated formation of ontologies presented in this thesis relevant.

The conclusion reflects the main results and conclusions of the thesis.

On the topic of the thesis 21 publications were published:

1) Bulat Kubekov, Janna Kuandykova, Irbulat Utepbergenov, Anar Utegenova. Application of the conceptual model of knowledge for formalization of concepts of educational content. 9th International Conference on Application of Information and Communication Technologies -AICT2015, Rostov-on-Don, Russia, 14-16 October 2015, pp.588-594.

2) Anar Utegenova, Toybaeva Shara, Ualieva Indira, Mathematical Basis and Information System Software for Educational Institutions Ranking. 9th International Conference on Application of Information and Communication Technologies -AICT2015, Rostov-on-Don, Russia, 14-16 October 2015, pp.594-599.

3) Uvalieva Indira; Garifullina Zhadyra; Utegenova Anar, Development of intelligent system to support management decision-making in education pýbl., 2015, 2015 6th International Conference on Modeling, Simulation, and Applied Optimization (ICMSAO).

4) Akhmediyarova Ainur; Kassymova Dinara; Utegenova Anar, Development and research of the algorithm for determining the maximum flow at distribution in the network; OPEN COMPUTER SCIENCE Tom: 6 Vypýsk: 1 Str.: 213-218.

5) Utegenova A., Kubekov B, Ditmur B., Zhaksybaeva N. Innovative paradigm of education of knowledge –competency form based on ontology. Journal of Theoretical and Applied Information Technology, E-ISSN 1817-3195, ISSN 1992-8645, Vol 95. No 21-2017.

6) Ýtegenova A.Ý., Toıbaeva Sh.D., Ratsıonalnye alternatıvy ıspolzovanıia oblachnyh resýrsov v vysshem obrazovanıi, Vestnık Týran, 2014.

7) Ýtegenova A.Ý., Kýbekov B.S., Ontologıcheskıi ınjınırıng v predstavlenıi ı organızatsıi ýchebnogo kontenta, Vestnık Týran, 2014.

8) Ýtegenova A.Ý., Mýstafına A.K., Alıbıeva J.M., Beketova G.S., Berlıbaeva A.B., Obektige baǵyttalǵan júıelerdi testileý, Vestnık NANRK, 2015.

9) Antonov A.V., Kýbekov B.S., Ýtegenova A.Ý., Ontologıcheskıi podhod v planırýemom obýchenıi. s. 103-105

10) Kýbekov B.S., doktorant PhD Ýtegenova A.Ý., magıstrant Zykın S.L. Kontseptsıia paradıgmy v zadache predstavlenıia ı organızatsıi znanıi. Sbornık trýdov , s.25-30. ISBN 978-5-905813-05-4

11) I.T. Ýtepbergenov, Ótegenova A.Ý., Mýslımova A.K., 2015, Vestnık VKGTÝ, №3(69), Avtomattandyrylǵan basqarý júıesiniń aqparattyq ınfraqurylymyn vırtýaldandyrý.

12) Ýtegenova A.Ý, Býbnov V.P., Sergeev S.A., Issledovanıe harakterıstık gıperdeltnogo raspredelenıia dlıa ego ıspolzovanıia prı postroenıi ımıtatsıonnyh modelei, V mejdýnarodnaıa naýchno-praktıcheskaıa konferentsıia, «Intellektýalnye sıstemy na transporte» (IntellektTrans-2015), Sankt-Peterbýrg

13) I. Utepbergenov, A. Utegenova, Zh. Kenzhebaeva, Sh. Sagyndykova, N. Toktasynova. The innovative approach to the automatization of the enterprise quality management system in business studio Proceedings of the .: Rost Publishing, 2015. p.10-17

14) Utegenova A. U. Utepbergenov I.T., Musabekov N.R., Kasymova D.T., Muslimova A.K., Integrated Approach for Implementing the Virtual Information Infrastructure of the automated process control system, International Conference

"Computational and Information Technologies in Science, Engineering and Education", Al-Farabi Kazakh National University Almaty, Kazakhstan, 2015g.

15) Bulat Kubekov, Anar Utegenova, Vitaliy Naumenko. Applying of ontological engineering to represent knowledge and training sessions. 10th International Conference on Application of Information and Communication Technologies -AICT2016, Baku (Azerbaijan), 12-14 October 2016, pp.115-118

16) Kýbekov B.S., Ýtegenova A.Ý., Antonov A.V. Proektnyı podhod ı planırýemoe obýchenıe na osnove ontologıı. Dvenadtsataıa Mejdýnarodnaıa Azıatskaıa shkola-semınar «Problemy optımızatsıı slojnyh sıstem». g.Novosıbırsk Rossıiskoı Federatsıı, 2016 goda.

17) Kýbekov B.S., Ýtegenova A.Ý., Antonov A.V. Ontologıcheskıı podhod v planırýemom obýchenıı. Pıatnadtsataıa otkrytaıa Vserossıiskaıa konferentsııa "Prepodavanıe ınformatsıonnyh tehnologıı v Rossıiskoı Federatsıı", 2017g., g.Arhangelsk, Severnyı (Arktıcheskıı) Federalnyı ýnıversıtet. s. 103-105

18) Kýbekov B.S., Ýtegenova A.Ý., Naýmenko V.V., Alenova R.A., Ontologıcheskıı podhod k semantıcheskomý modelırovanııý obrazovatelnyh programm v vysshem obrazovanıı. Trýdy konferentsıı «Sovremennye problemy ınformatıkı ı vychıslıtelnyh tehnologıı», IIVT KN MON RK, Almaty, 2018. – S 136-143.

19) Kýbekov B.S., Ýtegenova A.Ý., Naýmenko V.V., Jaksybaeva N.N., Metodıka formırovanııa obrazovatelnyh resýrsov na osnove ontologıı, Materıaly naýchnoı konferentsıı «Problemy optımızatsıı slojnyh sıstem» - Cholpon-Ata: IIVT MON RK, 2018.- S. 327-337.

20) Kýbekov B.S., Ýtegenova A.Ý., Naýmenko V.V., Balgabaeva L.Sh., Metodıka formırovanııa obrazovatelnyh resýrsov na osnove ontologıı, XVI otkrytaıa vserossıiskaıa konferentsııa «Prepodavanıe ınformatsıonnyh tehnologıı v Rossıiskoı federatsıı» MGTÝ ım. N.E. Baýmana- Moskva, 2018.- S. 96-97.

21) Kýbekov B.S., Ýtegenova A.Ý., Naýmenko V.V., Jaksybaeva N.N., Methodology of formation of educational resources on the basis of ontology, IEEE 12th International Conference on Application of Information and Communication Technologies, Almaty.- 2018.-S. 408-413.