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The Technology Management of Quality of the Content of Education

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Abstract : As for now, the higher interest in communication opens new and more affordable information technologies, creates opportunities to improve and updating ways to information dissemination. The proposed approach to forming the content of education in the qualitative provision of educational services will provide advantages: ability to prepare the target audience of entrants; professionally-oriented advice to entrants/students; saving of auditorial funds and places in dormitories; optimization of financial expenses of the university. The purpose of the study is to create new forms of presentation and methods of storage of knowledge (educational, informational content), activation strategy and knowledge; Creation of new learning strategies and study of the educational material. Applied to study the following methods: processing, accumulation; verification, integration and generalization of knowledge from a certain substantive field; general methods of knowledge; methods of system analysis; methods of mathematical modeling; creation and replenishment of lexicons. The paper considers the application of technology of processing of knowledge which at the expense of theoretically reasonable methodology of processing of knowledge, will allow to process and withdraw new valuable information. System components are characterized, a description of the process of developing these components: a database for saving the necessary information, building a user interface for managing the system. Practical value is oriented to design and implement the components of the automated system: databases and user interface to interact with the client-server part.

Keywords : information systems, educational process, data processing, naturally lingual information, methodology.

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1. Introduction

The socioeconomic situation that has emerged in Ukraine over the past decades requires the continuous development of all areas of the country, which can only be achieved by the presence of a powerful intellectual asset among scientists, specialists of Ukraine. Conditions that require an urgent improvement in scientific and educational activities have led to a total absence of motivation. Moreover, to clarify, it is essential to say that plenty of Ukrainian scientists and specialists are looking for work abroad. The part of them, which remained in Ukraine loses

inspiration because of the lack of resources, tools, and also support or faith in their business. In particular, monitoring studies of higher education in Ukraine allowed determining the level of learning of educational information and to find out the benefits and disadvantages, requirements for the content and structure of curricula. The comparative analysis of the results obtained revealed a possible interconnection between the effectiveness of higher education standards and the quality of training specialists. As for now, the higher interest in communication opens new and more affordable information technologies, creates opportunities to improve and updating ways to information dissemination (Aronson et al., 2019; Krumm et al., 2022; Alt & Raichel, 2020; Fialko et al., 1992).

According to the previous arguments, the development of management technology in the educational sector, taking into account attractiveness and quality indicators is a topical issue. The proposed approach to forming the content of education in the qualitative provision of educational services (distance training, online lectures, etc) will provide advantages: ability to prepare the target audience of entrants; professionally-oriented advice to entrants/students; saving of auditorial funds and places in dormitories; optimization of financial expenses of the university. The practice of attracting students of senior courses, postgraduates, and graduates to the formation of knowledge necessary to ensure professional training of people studying and planning to study in the universities of Ukraine shows high efficiency (Bonart et al., 2020; Shahzad et al., 2020; Syniavsky et al., 2020). Also, it corresponds to the concept of e-learning, taking into account the life cycle of the reproduction of knowledge. The university functions are reduced to the organization of the educational process formation of curricula, academic disciplines with a faculty and competent persons, so as a consequence of filling with such developments of educational information space (Soboleva et al., 2020; Tatenov et al., 2016). Accelerated relevance decrease, so-called, "aging" of knowledge in many fields complicate the processes and technologies of management of the qualities of the content of education (Badyorina, 2015; Badyorina, 2017; Dinzhos et al., 2020).

The purpose of the study is to create new forms of presentation and methods of storage of knowledge (educational, informational content), activation strategy and knowledge; Creation of new learning strategies and study of the educational material. Practical value is oriented to design and implement the components of the automated system: databases and user interface to interact with the client-server part. It is necessary to perform the task in the first stage:

1. To analyse the main normative documents that affect the organization of the educational process (curriculum, working educational curriculum, form of calculation of educational load K-3).

2. To determine the main features of document data, their structure, data containing these documents, and the type of submission.

3. The basis of the results of the first part of the work is analysed the volumes of data in the relevant documents, in the second part it is necessary to form an abstract model, which would reveal the nature of the relationship between information. The study of available models of databases allows you to choose the most convenient for implementing the task – a relational model.

4. To build an L-model of knowledge submission with the help of applied morphological analysis without a dictionary, which will enable the text documents based on the predicate form of submission.

5. To formalize the grammatical structures of texts to correctly handle the expressions using the method of removing homonymy, which will allow the use of the rules for the transformation of expressions in a significant form.

6. To conduct verification experiments.

Works on the development of the system for assessing the quality of educational services are carried out by the requirements of the Law of Ukraine No. 1556-VII "On Higher Education" (2014) (Section V "Quality of Higher Education"), Law of Ukraine No. 2145-VIII "On Education" (2017) (Section V "Quality of Education"), DSTU standard (ISO 9001: 2015, IDT) "Quality Management Systems. Requirements" (2015), and corresponds to the recommendations of the document "Standards and Recommendations for Quality Assurance in the European Space of Higher Education" (2015) of the

European Association for Higher Education Quality, other normative and information documents. Initially, the developed system has been focused on testing students of senior courses on knowledge of the subject area with specialty disciplines. In the process of designing the system, it became apparent that the developing software complex can serve as a basis for assessing the quality of educational services of departments, in particular, to improve the quality of education of the institution.

2. Materials And Methods

With the help of texts processing methods in the natural language, the implementation of which requires the presence of linguistic information as knowledge it is possible to solve the automation task of constructing ontologies. Applied to study the following methods: knowledge processing, their formalization and bringing to a single submission; accumulation of knowledge in a particular subject area; verification of knowledge contained in diverse texts on functional completeness, logical and semantic compatibility; integration and generalization of knowledge from a certain substantive field; general methods of knowledge (observation, comparison, classification); methods of system analysis for the study of the subject area and the development of information technologies of the educational sphere; methods of mathematical modelling; creation and replenishment of lexicons containing the necessary for the analysis of morphological and grammatical information.

Unlike traditional methods of recognizing, cognitive recognition of texts formalizes the removal and presentation of knowledge of the subject area contained in the natural language. The recognition procedure is based on methods of formalization (means the development of template models) of knowledge about a certain language and knowledge of the world (a subject industry) (Jungnickel et al., 2019; Sapazhanov et al., 2021). In this statement: as tasks of automation of recognition and extraction from natural language texts – knowledge of the subject industry, known research aimed at implementing dialogue support. In this case, communication components can be presented as follows:$k_1,k_2,k_3,\ldots, k_n$; the communicative text (a dialog); the processes of verbalization and understanding; an outstanding situation; the practical purposes; the communicative purposes.

The problem of processing phrases mathematical methods is solved in such a statement: method of decomposition of the model ⟨M, P⟩ by a set of variables on a plurality of models:

$$I=\{\langle M_{\sigma 1,\sigma 2,\ldots,\sigma i},P_{\sigma 1,\sigma 2,\ldots,\sigma i}\rangle\},\ \sigma k\in A,k=\overline{1,i} \quad (1)$$

is based on the theorem of decomposition. Let x_1, x_2, ..., x_i – the variables of the predicate, σ_1, σ_2, …, $\sigma i\in A$ – their value respectively.

The predicate that meets the relation $M_{\sigma 1,\sigma 2,\ldots,\sigma i}$, has the form formula:

$$M_{\sigma 1,\sigma 2,\ldots,\sigma i}\ (x_{i+1},\ldots,x_m)=M(\sigma_1,\sigma_2,\ldots,\sigma_i,x_{i+1},\ldots,x_m). \quad (2)$$

The predicate model $\langle M_{\sigma 1,\sigma 2,\ldots,\sigma i},P_{\sigma 1,\sigma 2,\ldots,\sigma i}\rangle$ the authors found by the formula:

$$P_{\sigma 1,\sigma 2,\ldots,\sigma i}\ (x_{i+1,\ldots,xm})=P(\sigma_1,\sigma_2,\ldots,\sigma_{i,xi+1,\ldots,xm}) \quad (3)$$

All of these ways thus obtained $M\sigma_1,\sigma_2,\ldots,\sigma_i$ and predicates, $P_{\sigma 1,\sigma 2,\ldots,\sigma i\ ,\sigma 1,\sigma 2,\ldots,\sigma i}\in A$ make a model, $\langle M_{\sigma 1,\sigma 2,\ldots,\sigma i,}P_{\sigma 1,\sigma 2,\ldots,\sigma i}\rangle$, forming a system:

$$I=\{\langle M_{\sigma 1,\sigma 2,\ldots,\sigma i,P\sigma 1,\sigma 2,\ldots,\sigma i}\rangle\},\ \sigma_k\in A,\ k=\overline{1,i}. \quad (4)$$

We should note that it is not necessary to decompose the mathematical model for the -units. This method is used for a predicate defined throughout the space. Using the method of decomposition of models by a set of variables, the mathematical model of the text is decomposed by a set of variables to the needed for simulation of language units. The problem of processing phrases mathematical methods is solved in such a statement.

3. Results And Discussion

The main components of knowledge in terms of their formalized submission are the concept, the relation between them, the characteristics of concepts and relations, as well as the modality of these characteristics. Consequently, the processing of the input text must be aimed at detecting (recognition) in the text of the main components of knowledge and the establishment of logic-semantic relationships between them to form the desired structure of the content of the input text. The information which is contained in text sources may be submitted in different languages, which determines the need to transform various incoming information into a single

submission in the knowledge base. It is also the basis and to synthesize the content description, which is displayed in a formalized submission. The following requirements are made to formalized knowledge. Firstly, it should be presented in this form, which will provide the possibility of correct logicsemantic knowledge processing; Secondly, it must contain all the necessary information to solve a certain problem, that is, the greatest content of the content level is to store the text representation of knowledge elements.

Automation of the process of linguistic processing of information is represented by a mathematical formalization connected by a set of formal systems that reflect the processing content at each level. This aggregate is organized into the corresponding hierarchical structure of formal theories, whose levels are consistent with each other in the interface. A theory i – level can be represented by the following: $T\_i=<A_i,S_i,P_i,R_i>$ where A_i – the input information for the i – theory that can be presented in a text form, a plurality of signs, a plural of dictionaries and so on; P_i the set of rules of the i – theory of linguistic processing A_i, R_i – the results of the use of rules P_i for processing A_i,S_i – formalized syntactic rules for representing all elements A_i,P_i,R_i.

The plural P_i in general case may include two groups of rules. The rules directly linguistic processing and the rules for using the rules of the first group. An analogue of the example of the second group may be a rule of use of a syntactic control rule. The elements of a plurality R_i as a result of the iterative use of the rules from the plurality R_i can be used as elements of a plurality A_i, in general $A_i \cap R_i \neq 0$. There is a need to develop several modifications T_{ij} some T_i. Taking into account the specifics of the text's characteristic of a particular subject area, the peculiarities of the practical tasks of processing text information arise the need for slight changes in the rules of linguistic analysis or the use of these rules and changes in the content of other components of the T_i-theory. The general $\{T_{ij}\}$theory represents a plurality with a ratio of the strict order of hierarchical subordination. On the other hand, T theory must be presented as a general formal system:

$$T=<A_T,S_T,P_T,R_T>, \quad (5)$$

where: A_T input information for the T-theory, P_T rules for using T_{ij} theories, R_T – the results of implementation of the rules P_T, $S_T$formalized syntactic rules "external" presentation of T_{ij} theories.

The need to represent the T theory in the form of a formal system is due to the following information. Firstly, due to the presence of modifications of T theory, it is necessary to clearly formulate the rules for using certain problems in solving specific tasks. The process of the linguistic analysis as a whole is iterative, therefore it is necessary to clearly formulate the rules for using the rules for attracting T_{ij} theories to process the information. In a process of linguistic research, an information base that provides automation of tasks processing of text information is created and investigated. This base may include different destination dictionaries (vocabulary of quasi – prefixes, quasi-endings, translated dictionaries, dictionaries of concepts in particular business industry, dictionaries of service words, etc.), which during operation of relevant information systems are replenished. The practical analysis of the mark level of the organization of natural-language text is limited by the department of syntactic punctuation marks from the word, allocation of abbreviations, abridgement, etc.

The general algorithm of recognition works with the following restrictions on the input text. The text is formatted on the left and right edges; The text does not contain transfers; The text does not contain tables, drawings, formulas, graphic characters; The text can be submitted in English, Ukrainian or German. Recognition of the grammeme level representation of the text is to build a graphemic structure of the text, which includes the selection on a plurality of lines and grammeme of input text: fragments (discourse), sentences, syntagmas, lexemes; determination of types (classes) of listed units of text and establishing relationships between them. The result of the grammeme analysis is the input information for both the linguistic text level (linguistic lexemes, language sentences) and for a pragmatic interpreter. The task of automated analysis is reduced to two parameters: the quality determined by the accuracy (the level of errors in the built-in syntactic designs of sentences, completeness (degree of coating with syntactic bonds, or the connectivity of the sentence graph), and the rate that is insufficient for applied tasks.

The essence of the recognition procedure is to attribute each language lexeme of the input text of the corresponding content information. Such information includes lexical-grammatical classes (noun, adjective, numerator, verb, etc.) corresponding to these classes grammatical characteristics (for instance, for nouns are the genus, the number, an

index), syntactic characteristics (the reference model is provided for prepositions only), semantic characteristics (they are rewritten by certain rules from the dictionary morpheme and represent a corresponding set of semantic features that bring prefixes and suffixes to the root of prefixes and suffixes, for example size, state, process, etc.). The standard model defines all characteristics inherent in a particular morpheme. Then an analysis of their interaction in a given lexeme is carried out, with a certain set of rules for solving the sets of signs for contradictory, compatibility. The result of recognition is an integrated set of features corresponding to a certain lexeme of the text.

Semantic recognition is also divided into two stages. The task of the first stage is to eliminate syntactic homonymy (if it occurs) and forming concepts, relationships, and their characteristics (properties) within the same sentence. Also, at this stage there is a substitution of anaphoric bonds (when instead of the concept is substituted by a pronoun), a generalization of concepts and relationships, passes of concepts and relatives inherently in nature. Objects of recognition, unlike syntactic recognition, there are all sentences (and not only linguistic), sentence-headers that are subject to processing in the second stage of semantic recognition when the proper design structure of the input text is being built. The input data of the semantic analyzer are the results of grapheme and syntactic recognition, as well as reference models that include thesaurus concepts, thesaurus relationships, and thesaurus of logic-semantic relationships. Multi-meaning of words is taken into account. From a formal point of view, the case of multivalued can be written as:

$$A_i \rightarrow \{Q\}, \qquad (6)$$

where: A is the current image (in this case, a word or phrase); i – a unique set of grammatical features that characterizes A in the current context; Q is the set of standard samples that are suited to A.

In the natural system, grammatical multi-values (homonymy) are distinguished in this way: the homonymy of grammatical characteristics of the word forms; lexical-grammatical homonymy, which arises at the level of lexical-grammatical classes. The solution of grammatical homonymy is carried out at the following levels. Thus, for grammatical homonymy – to the level of recognition of syntactic compounds (the level of phrases) (Fernández-Soto et al., 2018; Kilic & Cetin, 2019). For lexical-grammatical homonymy to the level of recognition of the syntactic structure of the sentence (the level of the sentence). Grammatical homonymy is eliminated due to the developed reference samples of syntactic bonds between the wordforms in the sentence (method of declarative representation of syntactic rules) – the rules of context (Akhmetova et al., 2020; Dolynska et al., 2020). Formally, the elimination of grammatical homonymy within the framework of the rules of grammatical agreement is to carry out the transaction of crossing the grammatical characteristics of the wordforms A and B:

$$\{G_A\}_1^n \cap \{GB\}_1^k \qquad (7)$$

In formalized form, the rule of grammatical agreement can be represented by the formula:

$$\Pi_{ga}: N_A \otimes N_B \Rightarrow \{G\}_1^r \qquad (8)$$

where: N_A– the code of the lexical-grammatical class of the word form, A, N_B – the code of the lexical-grammatical class of the word form, B, $\{G\}_r^l$ – a set of grammatical characteristics, which is the result of the operation of coordinating grammatical characteristics for the two-word forms (Figure 1).

It is necessary to prepare the knowledge base of this phase for the purpose of the next use. The result will be formalized thesaurus and dictionaries of terms and synonyms from subject industries. Information provision of the system includes several databases. The database is designed to store system data and

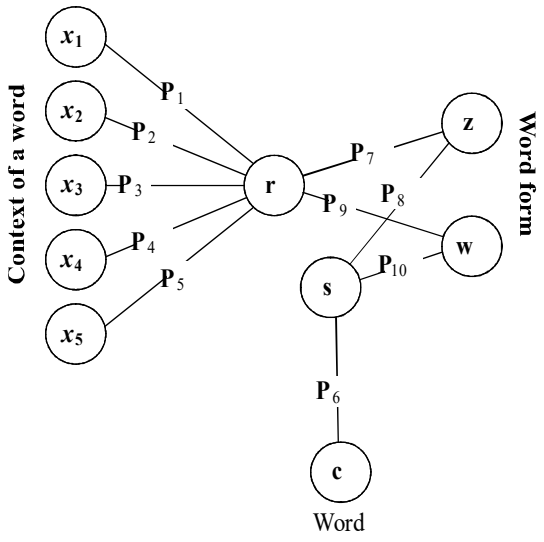

Fig. 1 : Processing of phrases

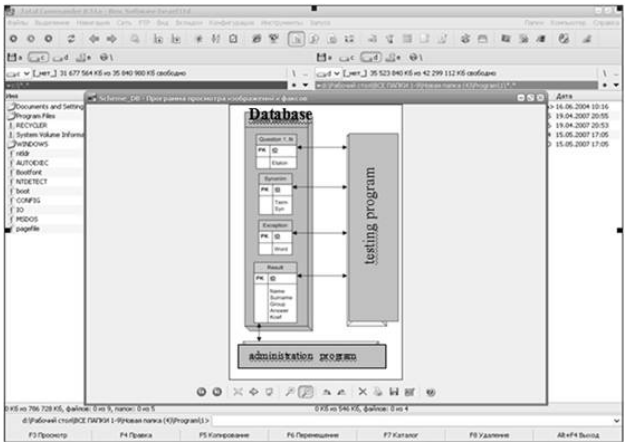

Fig. 2: Relationships between tables in the metabase

information exchange between different functional modules of the system. The information provision of the system is organized according to the principle of creating a data warehouse. The systemapos nucleus is a database that contains all information for different system modules. The semantic metadata of data contains a specialized database that contains data on a working database, a relational structure of the database. Creating a database is possible by means of a MySQL (Structured Query Language) database management system, and developing an interface – languages HTML (HyperText Markup Language), CSS (Cascading Style Sheets) and JSP (Java Server Pages), and jQuery technologies. The analysis is available for use in the development of database management systems. The selected MySQL database satisfies its functionality, auxiliary software, as well as the availability of reference materials requirements that arise when solving this problem (Figure 2).

The next stage of system development is to build a user interface. The created interface corresponds to the client part of the client-server architecture that interacts with the server part with HTTP requests. When developing it is used modern web-developing tools, which will allow you to create a simple and understandable user interface, to manipulate data available in the database, which is present in big data also to manage the process generation process.

4. Conclusions

Development of methodological tools of mathematical modeling will improve the efficiency and quality of information processing in natural language systems. The volume of data in the relevant documents is analyzed, in the second part is a simulated example, which reveals the character of the relationship between information. The study of available models of databases allowed the authors to choose the most convenient for implementing a task – a relational model. The presentation of knowledge with the help of applied morphological analysis without a dictionary, which will enable processing text documents based on the predicate form of submission. Formalized grammatical structures of texts to correctly handle expressions through removing homonymy, which will apply the rules for the transformation of expressions in a significant form. System components are characterized, a description of the process of developing these components: a database for saving the necessary information, building a user interface for managing the system.

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