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Aspects of developing English-Russian electronic dictionary on data analysis for IT students

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Abstract. *Problem statement*. The use of information technology has significantly transformed the field of education. Various electronic tools are successfully used in foreign language teaching. Electronic dictionaries offer expanded functionality, although their development remains a complex process and requires further research to optimize their use in education. *Methodology*. This study involves analyzing the aspects of developing an electronic dictionary that IT students could use for mastering English for specific purposes. The authors put forward the principles of lexical unit selection for the dictionary. Besides, didactical principles have been suggested to be used as a methodological foundation for the dictionary. *Results*. Based on the performed analysis, the study identifies key technical components for creating an electronic dictionary (databases, CMS, API) and highlights the importance of choosing a programming language for development. Various word search algorithms are also considered to enhance search efficiency and improve the user experience. *Conclusion*. The article highlights the key aspects of the electronic dictionary creation and emphasizes the importance of relying on certain didactic principles for completing the dictionary and implementing it in education process.

Keywords: information communication technology, electronic dictionary, teaching foreign language

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Аспекты разработки англо-русского электронного словаря по анализу данных для студентов IT-направлений

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Аннотация. *Постановка проблемы*. Использование информационных технологий значительно изменило сферу образования. Различные электронные средства успешно применяются в обучении иностранным языкам. Электронные словари предлагают расширенный функционал, хотя их разработка остается сложным процессом и требует дальнейших исследований для оптимизации использования этого средства обучения в образовании. *Методология*. Данное исследование включает в себя анализ аспектов разработки электронного словаря, который студенты, обучающиеся на IT-специальностях, могли бы использовать для овладения английским языком. Авторами предложены принципы отбора лексических единиц для словаря. В качестве методической основы словаря указаны дидактические принципы. *Результаты*. На основании проведенного анализа в исследовании определены ключевые технические компоненты для создания электронного словаря (базы данных, CMS, API), а также подчеркивается важность выбора языка программирования для разработки. Также рассматриваются различные алгоритмы поиска слов для улучшения эффективности поиска и пользовательского опыта. *Заключение*. В статье выделены ключевые аспекты создания электронного словаря и подчеркнута важность опоры на определенные дидактические принципы при создании словаря и его внедрении в образовательный процесс.

Ключевые слова: информационные коммуникационные технологии, электронный словарь, обучение иностранному языку

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Problem statement. The importance of information communication technology (ICT) in the modern world cannot be overestimated. The role of ICT in education should be noted in particular: it gives students access to a huge number of information sources and interactive learning materials [1]. It is safe to say that the modern educational process is unthinkable without the use of computers, Internet resources, online platforms and other innovative technologies that make learning more flexible, accessible, and oriented to student individual needs [2]. The use of ICT in education is especially relevant for IT students: the

nature of their future professional activity implies active use of digital technology. Another notable aspect of IT education is necessity to acquire English because a huge amount of documentation is written in English, and the international IT community uses this language for communication [3].

The use of information and communication technology has found wide application in foreign language teaching [4]. Teachers use electronic educational resources that present teaching material in an interactive form. N.A. Shegay and O.I. Trubitsyna point out the following advantages of using electronic educational resources in foreign language teaching: optimisation of practicing skills included in foreign language communicative competence, a variety of means of visualisation of teaching material, the possibility of automated control by means of online tests, etc. [5]. In addition, applications aimed at learning and practising grammatical rules and foreign language vocabulary are now widespread. It is noted that gamification of this process makes learning more exciting, which increases the motivation of language learners [6].

When it comes to using ICT in teaching, it is necessary to mention electronic dictionaries. Electronic dictionaries have also become widespread in foreign language teaching owing to their advantages over printed dictionaries [7]. For example, electronic dictionaries have extended functionality – it is possible to make quick edits to dictionary entries, provide articles with various multimedia materials illustrating concepts or giving information about word pronunciation [8]. Furthermore, word search is performed faster compared to a regular printed dictionary [9].

The development of the electronic dictionary is rather a labour-intensive process raising a number of issues, the resolution of which will contribute to a more effective application of the dictionary in the educational process [10]. Let us analyze the most important aspects of creating the electronic dictionary.

Methodology. First of all, it is essential to establish the principles that will guide the selection of lexical items to be included into the dictionary, as this selection is vital for addressing the needs of its intended readership. This aspect of dictionary development has been analysed by many specialists. For instance, N.D. Galskova points out that all the principles of lexis selection can be divided into three groups: statistical, linguistic, and methodological ones. Statistical principles include frequency and commonness. Frequency refers to the total number of times a word is used in a source or group of sources. Commonness is the number of sources where a word in question has been used at least once. Methodological principles rely on the aim of studying the language. Linguistic principles include the principle of combinability, the principle of stylistic unrestriction, the principle of semantic value, the principle of word-formation value, the principle of word polysemy, the principle of word building ability, the principle of frequency[1].

[1] Galskova ND, Gez NI. *Theory of foreign language teaching. Linguodidactics and methodology: training manual for students of linguistic universities and foreign language faculties of pedagogical higher education institutions*. Moscow: Akademia; 2004. (In Russ.)

T.M. Dementyeva states that "in defining special lexical units, the following linguistic principles become fundamental: semantic, word-formation value and multiple meanings of lexical units" [11, p. 137].

S.V. Kalashnikova, speaking of the importance of lexical selection, lays emphasis on sticking to "the principle of semantic value, in which the dictionary should include words that are significant for understanding professionally oriented texts, and the principle of combinability, where the dictionary favours terms that can be combined with other words" [12, p. 291].

Thus, having analysed the principles of lexical item selection, we can make the following conclusions. Firstly, it is obvious that the vocabulary to be used for teaching English to IT students should contain lexis from the relevant fields of knowledge, mastering which is necessary for a future specialist in this area. Besides, it is necessary to focus on constant update of lexis – in the rapidly developing IT sphere there frequently appear new lexical items that either describe previously non-existent concepts or replace something outdated. Also, words should be included based on the frequency of their use in professional literature. In addition, in cases when a word has more than one meaning, it is necessary to specify all variants of interpretation of this concept in order to present the terminology of the field in the most concise manner.

Therefore, taking into account the non-linguistic specificity of the discipline "Data Analysis", we believe that the following principles should be used when selecting lexical items for the English-Russian dictionary on this discipline:

1. The principle of frequency of use of the term in professional literature. The more frequently a term is used, the higher the probability of its inclusion in the dictionary.

2. The uniqueness principle. Some terms may have several meanings, and in this case, it is necessary to choose the variant that best matches the context of use.

3. The relevance principle. It is necessary to keep track of changes in professional vocabulary and update the dictionary accordingly.

4. The word-formation value principle. Its particular importance lies in the fact that words from which a large number of derivative words and expressions can be formed have a special value when included in the dictionary, since derivatives generate a larger number of lexical units relevant to the discipline in question.

In addition to the linguistic aspects, the process of developing the electronic dictionary implies the need to solve some technical tasks. The dictionary must contain a large amount of information and this may not be limited to the immediate dictionary entries, as depending on the purpose of the dictionary, it may also include illustrations, audio or video clips, and examples of the use of lexical units to provide context and other additional information to enhance understanding and improve information retention. The significant amount of information to be dealt with is precisely the reason why organizing the dictionary can be a challenging task, requiring non-standard approaches to indexing, data

structuring and storage. In addition, it is important to note the need to optimise the speed of the dictionary, as users prefer the resource to operate at the highest possible speed.

Alongside these important tasks that need to be addressed during the development of the electronic dictionary, it is essential to adhere to several pedagogical principles that will help to organise the dictionary in the most optimal way and contribute to its successful application in educational process. In our opinion, it is important to take the following didactic principles into account:

1) The principle of scientificity: information should be reliable and align with modern science.

2) The principle of clarity: the use of illustrations, videos and other means of visualisation helps to better assimilate the material.

3) The principle of accessibility: information should be understandable for all users, regardless of their competency in the subject area.

4) The principle of systematicity: this principle implies that all selected lexical units are thematically related, representing hierarchically selected thematic groups characterised by different types of relations. In addition, all materials should be structured in such a way that the user can easily find the necessary information.

5) The principle of individual approach: every user has their own specific characteristics in how they perceive information, so it is necessary to take into account their interests and needs when composing content.

Results and discussion. Having considered the methodological foundations of creating the electronic dictionary, it is also necessary to note technical components to be involved in this process. When developing the electronic dictionary, it is important to consider the following key components that determine its functionality:

1) database,
2) software,
3) search algorithms,
4) server infrastructure,
5) content,
6) component interactions.

Dictionary databases are the foundation of the electronic dictionary. A database is a set of data stored according to a data schema, manipulated according to the rules of data modelling tools[2]. The most common type that is used to create electronic dictionaries is relational databases. The information contained there is presented in the form of a table consisting of keys – attributes that uniquely identify an object in the database, and identifiers – unique numbers assigned to each item to distinguish it from other items. Besides, the logic of

[2] *Information technologies. Vocabulary: GOST 33707 2016: Interstate Standard* (promulgated: 1.09.2017). Moscow: Standartinform; 2016. (In Russ.) https://docs.cntd.ru/document/1200139532 (accessed: 7.10.2024)

relational databases implies the presence of two tables, the elements of which are linked by identifiers[3]. An example of a relational database implementation for creating the electronic dictionary involves two tables: the first one contains words in one language, while the second one contains their translations in another language. The keys for pairs of words that are translations of each other are identical.

Relational database management systems (RDBMS) such as MySQL, PostgreSQL, and Firebird are used to work with relational databases[4]. Specialists point out a number of advantages of relational DBMSs, such as: data consistency and integrity, ease of data retrieval and processing, scalability, and powerful ecosystem and compatibility[5].

As far as the software used in the creation of the electronic dictionary is concerned, the following necessary components should be highlighted:

1) CMS (Content Management System, also known as "CMS-engine", or "engine") is software for developing, editing, and structuring an application. Its particular importance lies in the ability to add items to the dictionary and make changes without having to edit the dictionary structure itself.

2) Programming language for writing the code and coordinating the interaction of the dictionary components. Selecting a programming language influences the dictionary performance, memory consumption, and dictionary development speed. It should be noted that each language has both advantages and disadvantages to be considered taking into account the purpose of creating the dictionary. Thus, the advantages of the Python programming language include the relative simplicity and brevity of the syntax, which simplifies and speeds up the development process. In addition, Python supports libraries for natural language processing (NLTK), data manipulation (Pandas), and web application development. The disadvantages of choosing Python for creating the electronic dictionary include low performance. Java and C++ provide maximum performance but dictionary creation takes more time and effort due to the complexity of the syntax. JavaScript language is used for both frontend and backend development, which simplifies the process of building the dictionary. Moreover, JavaScript supports many libraries and frameworks for the task in question. However, this programming language is also inferior to Java and C++ in terms of performance.

3) API (Application Programming Interface) is a software interface that allows for organising interaction between computer programs. Application of API when developing the electronic dictionary allows expanding its capabilities and providing integration with other services.

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[3] Komarov VI. *A guide to databases*. Moscow: DMK-Press; 2024. (In Russ.)

[4] Kulikov SS. *Working with MySQL, MS SQL Server and Oracle in examples: practical guide for programmers and testers: training manual*. 2019. (In Russ.) https://svyatoslav.biz/database_book/

[5] Mamedli RE. *Database management systems: training manual*. Nizhnevartovsk: Nizhnevartovsk State University Publ.; 2021. (In Russ.)

Word search algorithms play a crucial role in electronic dictionary functioning, the efficiency of the developed tool directly depending on them. Among the word search algorithms used in electronic dictionaries are the following:

- Linear search: consists of checking each word alphabetically until the desired word is found. It is the simplest algorithm, its execution taking a considerable amount of time.
- Binary search: the dictionary is divided in two halves, and the desired word is searched in both halves. Execution of this algorithm takes less time than linear search, but requires preliminary division of the initial array of words.
- Prefix trees: when implementing this algorithm, words are treated as a sequence of symbols in a tree structure. This algorithm allows to quickly search words by prefix (for example, all words beginning with "auto-").
- String matching algorithms (e. g. Levenshtein algorithm): used to find a word even if it is misspelt.
- Lemmatisation algorithms: determine the initial form of a word (lemma), excluding endings and inflection.
- Morphemic analysis algorithms: break a word into its constituent parts (morphemes) to determine its grammatical characteristics.

Conclusion. Thus, the article presents key aspects of the development of a specialised English-Russian electronic dictionary aimed at IT students studying data analysis. Particular focus is given not only to linguistic issues of lexical item selection and organisation, but also to technological solutions underlying the creation of a modern and user-friendly electronic resource. The article emphasizes the importance of observing didactic principles such as scientificity, visibility, accessibility, systematicity and individual approach to ensure the effectiveness of the dictionary as a learning tool. The authors have developed such criteria of lexicon selection as frequency, uniqueness, relevance and word-formation value. These criteria take a special place in the context of the dynamically developing subject area of data analysis.

In conclusion, it should be noted that the development of a specialised electronic dictionary for IT students from the point of view of an effective learning tool is a complex and complicated process that requires a deep understanding of both linguistic, pedagogical and technological aspects of the developer. We believe that adherence to the principles outlined in the article and the use of the described technologies will help to create an effective learning tool that meets the needs of modern educational environment.

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