

Reference and Educational System LexSite-LexTutor as Information Technology for Foreign Language Learning

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Abstract. The paper describes the reference and educational system LexTutor based on the English-Russian and Russian-English Internet dictionary LexSite. Both systems were developed by the authors of this paper based on their research in the field of natural language processing. This educational technology can be used for learning English by Russian-speaking students and learning Russian by English-speaking students of higher education schools including distant learning students.

The new tool has bilingual user interface. It enables users to create and maintain personal learning dictionaries using the lexical database. Another part of this reference and educational system is a collection of subject-specific public dictionaries designed by the LexSite team. The public dictionaries are available for all users. Both personal and public dictionaries are equipped with the flash session function that helps learn the lexis and check the results. Flash cards are created automatically from the dictionary entries. The system also offers tests on lexis being learned. Users can obtain their learning curves computed from the results of tests taken. The personal dictionaries can be shared with other users, which, in particular, is important to teachers willing to monitor the students' learning progress.

The authors of this paper continue working on development of new educational tools based on the LexSite dictionary that match the higher education standards and help overcome the educational barriers.

Keywords: Natural Language Processing, Database, User Interface, Higher Education, Higher Education Standards, Distant Learning, Educational Barriers, Informational Technologies (IT) for Language Learning, Online Dictionaries, Language Learning, Internet-Dictionary LexSite, Reference and Educational System LexTutor.

1 Introduction and Background

International cooperation in science, industry and business is an integral part of modern societies that involves cross-language communications. This necessitates acquisition of knowledge of foreign language by the professionals and requires development of the information and communication professional educational environment in higher education [1] "Intercultural competence being one of the system-formatting element of the specialist's innovative language personality in many ways defines his or her competi-

tiveness both on the internal and international labor markets” [2, p. 250]. Foreign language knowledge helps communicate with foreign professionals, use imported equipment, read foreign papers on the subject and publish papers in foreign journals and conference proceedings.

This becomes rather important in the IT industry and education, since IT-professionals are on the frontier of science and technology. The most demanded language in the IT professional field is English. Apart from the importance of English as the international natural language, English terms are widely used in the programming languages and scripts, which makes the knowledge of English compulsory for those involved in software development, testing, quality control, deployment and maintenance. The need to facilitate efficient learning of English by the students of the higher education schools (including distant learners) calls for special customized learning tools.

Online bilingual dictionaries are among the most essential tools used in foreign language studies. Their ability to communicate interactively with the learners in the course of their studies [3] opens the opportunity for transformation of the bilingual Internet dictionary from an informational object into a reference-tutoring entity.

This opportunity was exploited in the development of the English-Russian / Russian-English online dictionary LexSite by the authors of this paper [4], based on their research in the field of natural language processing. This paper discusses the educational system LexTutor integrated with the LexSite dictionary and designed for development of the students’ English vocabulary.

Learning languages through vocabulary building only one of many techniques employed for that purpose and this method is often overlooked by teachers and learners. In particular, there is a widely shared opinion that reading and guessing the meanings of words and expressions is the best way to learn languages. Research and experiments conducted by B. Laufer demonstrated that “Teachers have to look more critically at learning through reading and be more accepting of direct learning...” [5, p. 584].

Some teachers rely upon unsupervised learning. “Incidental acquisition is the primary means by which second language learners develop their vocabulary beyond the first few thousand most-common words.” [6, p. 190]. This statement does not account for the fact that the “first few thousand most-common words” are the hardest to acquire and that is where extensive efforts are needed.

Yet, professional teachers tend to appreciate the value of vocabulary development. For instance, Cheryl Boyd Zimmerman, a professor of TESOL at California State University points out: “Vocabulary is central to language and of critical importance to the typical language learner. Nevertheless, the teaching and learning of vocabulary have been undervalued in the field of second language acquisition” [7, p. 5].

Vocabulary development is among toughest challenges the learners of foreign languages face. In this development, the role of the dictionary cannot be overestimated. Numerous works stress the importance of dictionaries in the learning process. “As sources of words, and of information about words, they [dictionaries] are unequalled” [8, p. 60]. For many learners’ vocabulary development is a challenging task where most efforts shall be taken by the learners on their own. “One’s personal vocabulary is an individual achievement and possession, poor or rich though it may be.” [9, p. 125]. This

implies that lexis acquisition heavily depends on personal mindsets. “Beyond these indispensable items, the needs of the language learner in the area of vocabulary become very personal, depending on individual interests and objectives, and the situations and topics associated with this.” [9, p. 118].

Another aspect of this challenge is the shift in the mindsets of the learners. Due to rapid globalization, foreign language acquisition has become a necessity for many nations that had never experienced the need for this knowledge before. On top of that, the recent generation of learners’ view knowledge as an asset that can be acquired through the use of modern technologies without systematic long-term learning. The so-called Generation Z (that includes people born between 1995 and 2012 and where today’s IT students of the higher education schools belong to) views the world quite differently than the previous generations. For that generation certain seven key traits are typical, and the first among them is “1. Phigital: Gen Z is the first generation born into a world where every physical aspect (people and places) has a digital equivalent. For Gen Z, the real world and the virtual world naturally overlap. Virtual is simply part of your reality.” [10, p. 19]. However, this holds for other user categories as well. Zh. Chen in the study on the importance of vocabulary knowledge in English as a Foreign Language reading performance underlines that “the access to a bilingual electronic dictionary has a significant effect on the reading comprehension score for both high verbal ability group and the low verbal ability group.” [11, p. 84].

Responding to these historical, technological and cultural changes Language Interface expanded and enhanced its LexSite project to address the need for new methods and technologies in vocabulary acquisition.

It is worth noting that the authors’ observations match those made by other scholars. In particular, many features implemented in the LexSite project discussed below are in full compliance with the recommendations made by Scott Thornbury in his book *How to Teach Vocabulary* [8].

2 The LexSite Dictionary Project

The English-Russian and Russian-English Internet-based dictionary LexSite forms an information retrieval platform for informational and relevant linguistic purposes [12]. The lexical dataset of LexSite is based on materials acquired and systematized in the course of two decades of Language Interface operation as a translation service provider for a wide range of international projects – from United Nations’ reports to the International Space Station Program. The dataset was verified against proven sources such as bilingual dictionaries and glossaries. The dataset also includes terms of science and technology, as well as some high-frequency professionalisms. The program that processes users’ queries takes into account morphological specifics of both languages. The dictionary offers playing audio samples of pronunciation of Russian and English words and expressions.

Further evolution of the LexSite project shifts towards tutoring and learning features called LexTutor, which forms an integral part of the dictionary. The primary concept behind its design is to make every user’s action serve the user’s learning needs so that

the user's vocabulary is continuously expanded and enhanced [13]. The project enables learners to implement both direct and indirect learning strategies. While direct strategies are traditionally accomplished by dictionary usage, indirect strategies, such as self-planning, self-monitoring, and self-evaluating are supported by certain features of LexTutor. "Indirect metacognitive strategies are recommended to be highlighted in teaching and learning vocabulary as it has a stronger correlation with vocabulary knowledge. It has ways of helping learners exert more effort in self-control of their learning processes" [14, p. 58]. In the following sections we will demonstrate how each function contributes to this purpose.

The tutoring features support the following user activities:

1. Creation and maintenance of personal dictionaries.
2. Vocabulary development through the use of public dictionaries.
3. Lexical knowledge acquisition using electronic flashcards.
4. Knowledge sharing with other learners or between teachers and students.
5. Self-testing the knowledge acquired and viewing the learning curve.

Overall, the relevance of words and expressions to the user and the matters being learned is one of the main points in this design. This relevance is ensured by selection of entries in the dictionaries, both personal and public, enforced through selection of the dictionary subject matter and supported by provided learning aids.

LexTutor system graphical user interface is available in the English and Russian languages.

3 Personal Dictionaries

Personal dictionaries (Fig. 1) offered to a user, initially come as empty dictionaries that can be filled by learners in accordance to their intentions. These dictionaries help users meet their specific lexical needs and optimize foreign language studies. "The study shows that that fulfilment of a translator's lexical need through dictionary queries is a preferred way to develop lexical competence and personal lexical space." [15, p. 145]. Queries for translations directed to personal dictionaries are even more efficient due to the targeted nature of those dictionaries.

LexTutor users can create and maintain any number of personal dictionaries targeted to any particular lexical needs of the user with its content covering certain subjects or texts; these dictionaries can be rearranged, enhanced or made more concise, deleted, printed and downloaded.

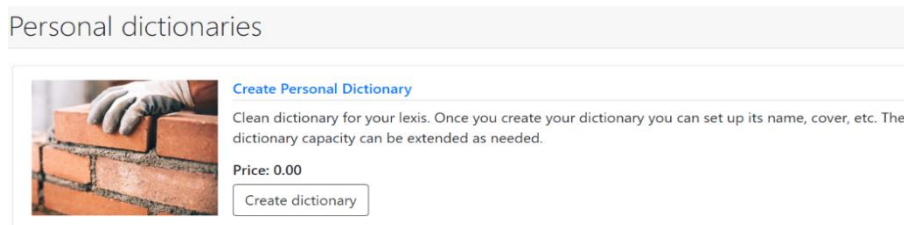


Fig. 1. A Blank Personal Dictionary.

By creating and maintaining their personal dictionaries users learn new words and find previously unknown translations for those words they felt they knew well. An example of this action is shown on Fig. 2. LexTutor offers the translations that are in its dataset. Not only the user gets a comprehensive dictionary, but also the very process of adding words is a learning activity.

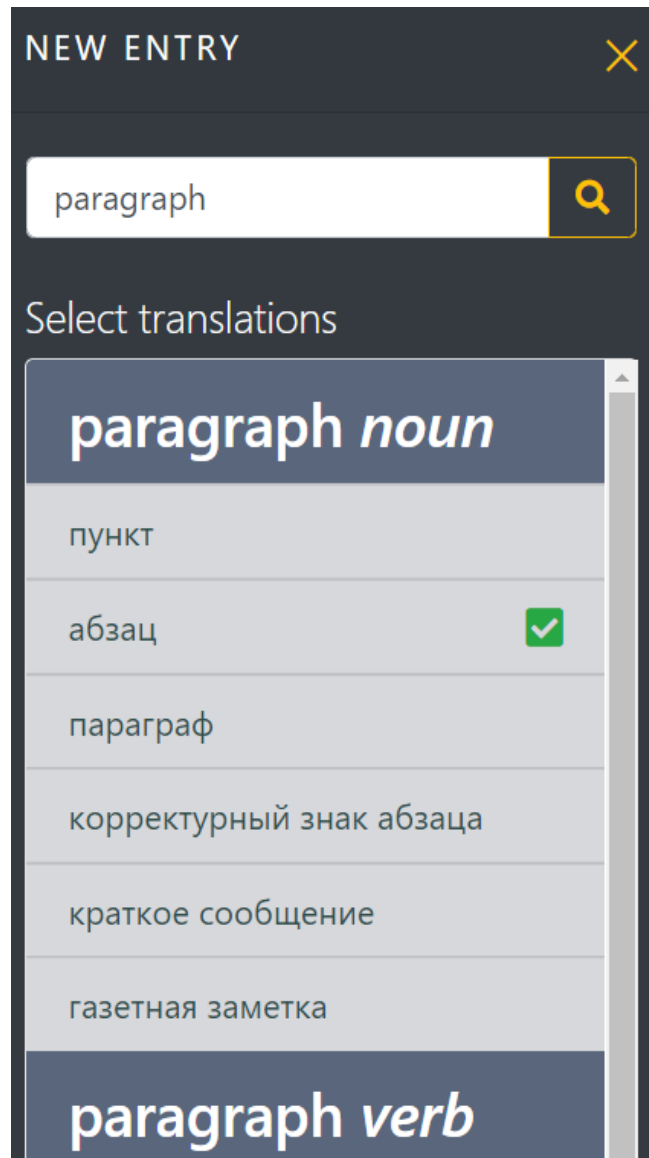


Fig. 2. Adding Translations to a Source Word.

The entered headwords are automatically placed in the alphabetical order. The dictionary owner has the option to customize the order of the entries so that, for example, months or days of the week can be placed in natural order. The dictionary owner also can place the entries in the order of their first occurrence in the text.

It should be noted that a learner who faces the need for development of his/her own personal dictionary has to decide what headwords are to be included there. This decision may be based on various reasons:

a) The learner has a text to translate (e.g. a homework assignment or a text of personal choice) from which he has to extract unknown lexical units, translate them and bring into some kind of a system or

b) The learner studies a subject for which the new words are needed. Both scenarios are also valid for a teacher who either prepares a text-related dictionary whether for testing or teaching purposes or creates a subject-targeted dictionary.

In the second scenario, the selection of headwords becomes a problem, especially if the user is unfamiliar with a subject matter. For instance, a teacher/learner who needs to develop a short dictionary of metallurgical terms while not being an expert in the field.

The needed headwords can be found on the Internet or in reference literature and then entered into the personal dictionary. Even though this may seem to be a “reinventing the wheel” activity, it is far from that because with LexTutor this necessitates typing the headwords (memorization by typing), selection of needed translations from the list offered by LexTutor and checking the results in the dictionary. From that time on this personal dictionary becomes available for learning and refreshing the knowledge acquired at any time and any location since it is kept on the Internet and accessible virtually from anywhere.

Similar approach is taken for adding new headwords along with their translations to the dictionary. The user is free to select any combination of translations for the desired headword thus expanding the dictionary or changing the focus of the lexis included in the dictionary. This ensures flexibility in selecting translations that are most relevant to the topic being studied, such as mineralogy, organic chemistry, IT-technology etc. and/or most appropriate for the geographical relevance of the term.

For example, for the Russian word *кефир* LexTutor suggests *kefir* and *buttermilk*. While both translations are valid, those interested in American version usage may choose to use *buttermilk* since this product is very common in U.S. food stores.

Same approach is employed for dictionaries developed to be used in connection with literary works. As an example, Fig. 3 shows a dictionary that covers lexis used in the musical number *Been a Long Day* from musical *How to Succeed in Business Without Really Trying* by Frank Loesser.

By learning the connection between the source word and its translation within this specific context the learner gains the knowledge of both the literary work and the particular usage of the word. The built-in learning aids give the user additional advantage.

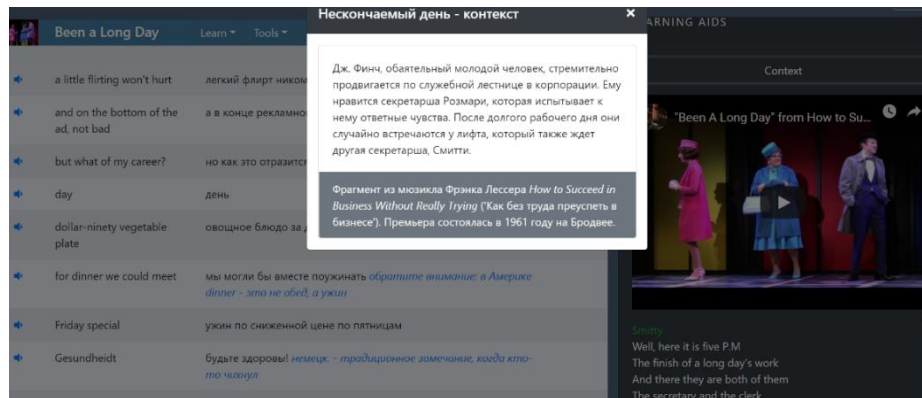


Fig. 3. Example of a Dictionary Related to a Literary Work with Built-in Learning Aids.

4 Public Dictionaries

Users whose skills are insufficient to create their own personal dictionaries or those who prefer to follow the paths chosen by lexicographers and teachers can take advantage of public dictionaries created for them in the framework of the LexSite project. A screenshot on Fig. 4 shows a part of LexTutor's collection of public dictionaries.

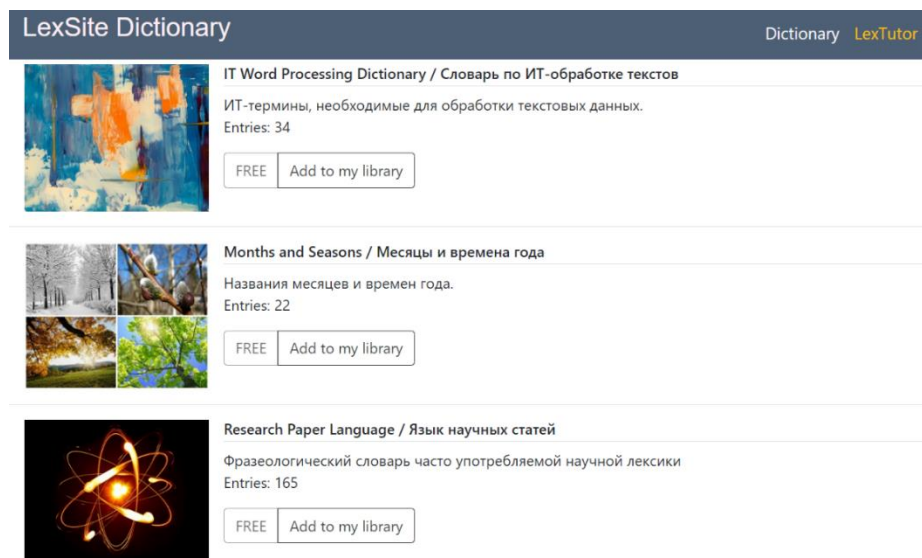


Fig. 4. A Fragment of the Page Showing Public Dictionaries Offered to the Users.

Table 1 lists a few of LexTutor's public dictionaries with their specifications.

Table 1. Examples of Public Dictionaries Available for the Users of LexTutor.

Title	Description	Source Language	Audience
Family	Words and expressions related to family and kinship	English	Beginners
City	City-related words and expressions	English	Beginners
Class Studies	Lexis related to studies in class	English	Beginners
Fruit and Vegetable	Names of fruit and vegetables	English	Beginners
While the Auto Waits	Lexis used in the short story by O.Henry	English	Advanced learners
Brush Up Your Shakespeare	Song from the musical Kiss Me Kate	English	Advanced learners
Семья	Words and expressions related to family and kinship	Russian	Beginners
IT Word Processing Dictionary	ИТ-термины, необходимые для обработки текстовых данных	English	Advanced learners
Язык научных статей	Фразеологический словарь часто употребляемой научной лексики	Russian	Advanced learners
Псалом	Lexis used in the short story Psalm by Mikhail Bulgakov	Russian	Advanced learners

The LexTutor library of public dictionaries is continuously updated and enhanced to meet the needs of most learners.

5 Flash Cards

Foreign language learning with the use of flashcards is widely used and has proven to be an efficient teaching and learning technology. This method had been introduced in mid-nineteenth century by the British educator and writer Favell Lee Mortimer [16] and became a widespread teaching methodology in the second half of the 20th century due to its promotion by the German scholar Sebastian Leitner who developed the method of spaced repetitions [17]. “There is probably no vocabulary learning technique more rewarding than the use of word cards.” [8, p. 145].

By the same token, Paul Nation points out that the use of “word card testing” is one of the most “useful vocabulary learning exercises that require little or no preparation.” [18, p. 3].

LexTutor offers its users to take advantage of this method by running flash sessions. The content of the dictionaries, both personal and public, is automatically transformed into sets of flashcards. To run the flash session the user chooses Flash session button which is located among the other learning functions (Fig. 5).



Fig. 5. Flash Session and Other Learning Functions.

The session is a sequence of randomly chosen flashcard images. Scholars have found the need for random selection of cards. “In any case, the cards should be shuffled periodically to avoid 'serial effects' – that is, remembering words because of the order they come in and not for any other reason“ [8, p. 146]. Each flashcard shows the headword and its translation or translations. If the user wants to test himself, he can turn off the translations and will view only headwords. “Learners test themselves on the words by first recalling the meaning of the new words – i.e. looking at each new word and then checking their understanding of each one by looking at the word's translation“ (ibid). The user can also turn on/off audio player that automatically pronounces each headword.

With the audio pronunciation feature enabled, the learners can build and secure the mental link between the word image, its meaning and audio representation. The feature offers either American and British English pronunciation styles to choose from. Turning the feature off may be helpful for the learner when skills testing is sought.

Card reversibility enforces the process of learning new words and expressions with flashcards. “They [learners] then reverse the process, using the translation to trigger the form of the new word.” (ibid). Learners can memorize translations from the source to target language and then, reversing the cards, check their knowledge for translations of the same words from the target to source language. Fig. 6 and 7 show reversible cards serving the same headword.

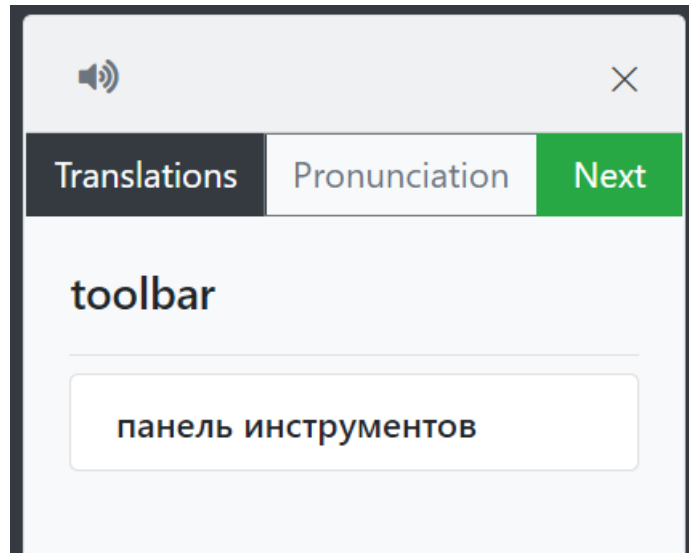


Fig. 6. Electronic Flash Cards Help Memorize Words/Expressions and Check the Knowledge of Them.

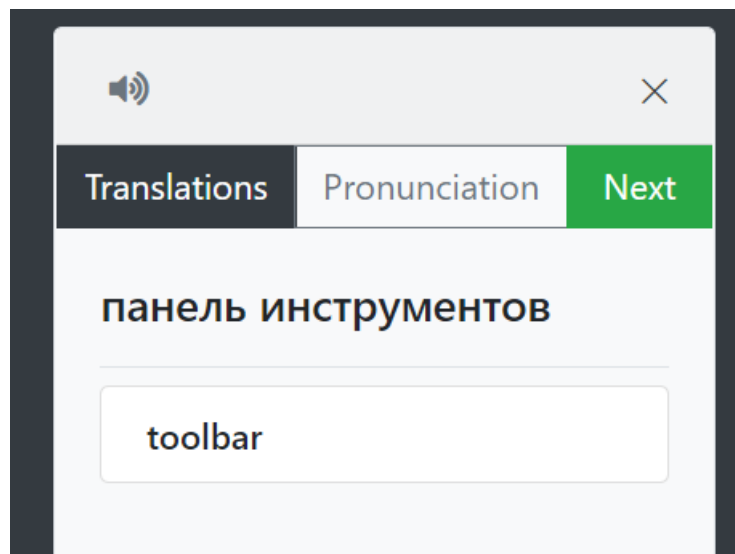


Fig. 7. Reversing Flash Cards.

To achieve sustaining results, it seems to be imperative to use flash card continuously and consistently. “To train learners to adopt this technique – and to always carry around with them a set of cards – it pays at first to supply students with blank cards until they get into the habit of obtaining their own. Hand out the cards after a vocabulary-rich stage of a lesson and demonstrate how to prepare half a dozen cards, letting individuals

choose which words they want no learn.” [8, p. 146]. In line with this recommendation in the context of the new generation’s phycology for which a phone in the pocket is a vital necessity, LexTutor offers immediate capability to use its virtual flashcards since they are available at any time on the mobile phone or a notebook computer. This also expands the flashcard learning concept, allowing to apply machine learning techniques and rapidly changing learning methodologies to each individual learner where specifics of the learner’s personality are taken into account.

6 Dictionary Management

When learning language, the user may need to manage their personal dictionaries. LexTutor enables its users to do so. Fig. 8 shows the management features available to the dictionary owner.

IT Word Processing Dictionary			Изучать ▾	Инструменты ▾	Добавить слово
✦	ampersand	знак & сокращение союза and	✓	✕	
✦	asterisk	звездочка название символа	✓	✕	
✦	bracket	скобка	✓	✕	
✦	cell	ячейка	✓	✕	
✦	cipher	шифр	✓	✕	
✦	close	закреть	✓	✕	
✦	colon	двоеточие	✓	✕	

Fig. 8. Dictionary Management Bar and Icons.

In the dictionary lifecycle there can be a need to add, remove or edit entries, delete the dictionary or change its profile and all these functions are included in the dictionary management toolset indicated with uniform icons (a “pen“ for editing, a “cross“ for deleting) or expressed by the word: add entry.

Unlike personal dictionaries, the public dictionaries are accessible for management only to the approved LexSite lexicographers and are available to other users as read-only assets.

7 Additional Educational Features

In addition to abovementioned activities, users may want to take a test (either express or full) that is available among the other learning functions (shown above on Fig. 5). The test allows to quickly check knowledge of words and expressions included in particular personal or public dictionary. It consists of cards each showing one headword and suggested translations. User has to choose one correct translation.

The button *Tools* provides the options *Analytics* and *Share dictionary* (Fig. 9).

IT Word Processing Dictionary		Learn ▾	Tools ▾	Add entry
▶	ampersand		Analytics	Share dictionary
▶	asterisk		звездочка	название символа
▶	bracket		скобка	
▶	cell		ячейка	
▶	cipher		шифр	

Fig. 9. Additional Tools.

The *Analytics* shows user's learning curve which is a result of tests taken. This option is available to users who have taken at least one test. The test results are displayed in graphical or tabular format (Fig. 10).

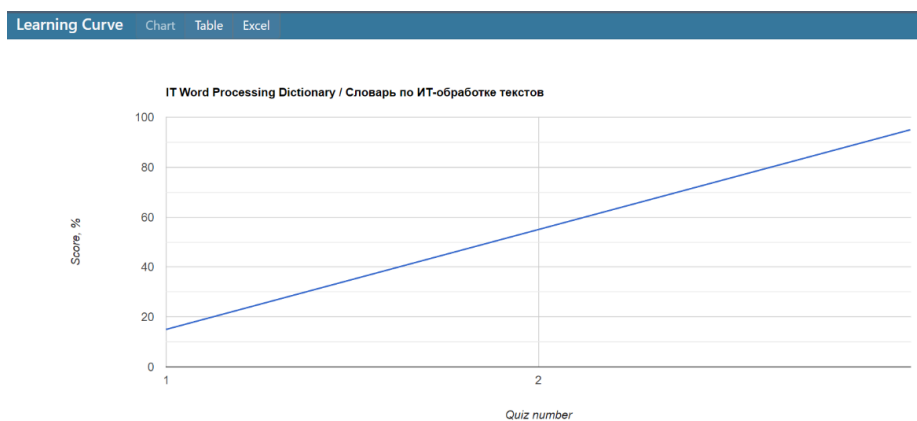


Fig. 10. Tests Results in Graphical Format (Learning Curve).

Another additional tool is the capability of sharing the personal dictionary with other users. Thus, the personal dictionary owner can give the access to his dictionary to the peers or to the teacher who wants to take advantage of monitoring the student's learning success.

8 Conclusion

“As a teacher, possibly a learner, and definitely a user of words yourself, you should share your sense of the excitement and fascination of words with your students. Vocabulary learning never stops, even long after the grammar system is firmly in place.” [8, p. 160].

In accord with this statement we, as educators, have developed and continue to enhance LexTutor in order to expand learners' capability to comprehend and deepen their knowledge of the English language and English language-based culture that match the higher education standards.

In summary, LexTutor responds to the cognitive needs of English language learners and helps to overcome the educational barriers. It facilitates both direct and indirect learning strategies, motivates the learners by personalization of vocabulary building, uses contexts for vocabulary development through video and textual learning aids. This method is applicable to all learners regardless of their linguistic competence – from beginners to seasoned translators who can use it for development of terminology dictionaries that cover certain fields of knowledge or specific projects.

Since the graphical user interface of LexTutor is designed on both English and Russian languages, the system can be used for studying English by Russian-speaking learners and for studying Russian by English-speaking individuals [19].

Besides, the methodology for personal dictionary development can be used to learn other European languages. E.g. students who learn French can create Russian-French or French-English personal dictionaries filling the dictionaries on their own.

And what is next? What happens when the learner feels completely comfortable in foreign language discourses? Indeed, vocabulary learning never stops and, following this path, we enable our users to create their own terminology bases, share knowledge with colleagues and like-minded users and, along this road, discover new horizons for comprehension and perception of this world to themselves and others.

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