

Electronic system for acquiring foreign language skills: mechanism for the formation of speech skills

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Abstract. The main goal in teaching a foreign language is the formation of a learner's untranslated command of a new language. Even modern electronic technologies will not allow creating an effective system of teaching a new language if the principles of its functioning are not based on the fundamental mechanisms for the formation of speech skills. It is necessary to speak with full confidence about the need to introduce the student's psyche into the educational process management control loop. It is this psycholinguistic approach that is the basis for creating an electronic system for acquiring foreign language skills. Its use will lead to a synergetic effect in the learning process and as a result accelerated creation of a new language zone in the minds of adult learners due to a sharp increase in the effectiveness of exercises by transforming grammatical information from verbal to graphic form. The main result today can be considered a conceptual solution to the problem of simultaneous interaction of the language system and the means of information and communication technologies that ensure the sustainable formation of foreign language thinking of adults in the process of developing professional and language skills presented at the system level.

1 Introduction

The ability to communicate in a foreign language is most quickly achieved through progressive mastery of labor skills while simultaneously developing the entire language system, which implements the speech skills of a new language very accurately and in a timely manner necessary for the student in his daily activities. This is the only way to form thinking in a foreign language quickly enough in which the presentation of thoughts takes place in accordance with the norms of the new language system acquired for its expression in everyday speech. In addition, the use of modern information and communication technologies (ICT) combined with the use of effective models for obtaining labor and language skills can significantly speed up the learning process and increase its success.

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Modern research is interdisciplinary and is at the intersection of activity theory, cognitive psychology, linguistics, ICT, and systems analysis.

The development of educational approaches for specific fields of knowledge is always associated with solving the problem of finding the most effective teaching methods. Those methods that work even within one area of knowledge are ineffective in the transition from the transfer of information to the process of skill formation. Education systems being one of the most conservative systems of society do not keep up with scientific and technological progress and social changes, do not have the capabilities and sufficient resources to solve the tasks of quickly preparing a large number of adults for language, social and industrial activities. In addition, the coronavirus epidemic that has befallen the whole world has aggravated all social problems many times. We live in a time when the main state structures simply do not cope well with the duties assigned to them:

- healthcare systems sometimes fail to cope with their functions, and medical staffs are forced to show real heroism in order to save people;
- education systems are not able to train people in professional and language skills in a sufficiently short time as a result of which the migration crisis turns into a catastrophe and this is becoming especially relevant now during a pandemic.

The transition to remote learning is a forced measure, but the distance education practiced cannot show decent results in any way. And this is determined first of all by the existing vicious tendencies to use the same approaches both for classroom and distance learning. In addition, it is necessary to distinguish between the transfer of information about the subject of training or the formation of skills: if in the first case we can talk about an improved version of classroom training, then in the case of the formation or acquisition of skills, the vast majority of teachers consider distance learning at best as tutoring with a limited number of trainees.

Learning curves (acquisition of knowledge) and skills training (acquisition of skills) have different forms (Figure 1) and numerical parameters, unjustified transfer of methodological techniques from one field of application to another leads to unreasonably slow progress or its complete absence.



Fig. 1. Dependence of the levels of knowledge and skills on the number of repetitions.

The main task today is to further advance from distance to full-fledged e-education. However, we especially cannot use those traditional educational technologies that will not bring the desired effect, but will only undermine faith in new approaches. Therefore, it is necessary to develop such teaching methods that will most fully satisfy the educational needs that have arisen and will form the basis of electronic educational systems.

The relevance of the topic is determined by the need to create a new detailed technology for the formation of speech skills in the electronic learning management system (LMS) for adult students of a foreign language. A special role is assigned to solving the problems of the development of managerial science and innovation in Europe, the implementation of a new policy in the field of education and its digitalization, the use of science-intensive technologies in business and public administration.

2 Trends in foreign language proficiency levels in some regions of Europe

Most countries have their own or adapted teaching methods and mechanisms for assessing the level of foreign language proficiency approved by the ministries of Education as well as countless courses based on the most advanced techniques. However, only large international corporations can objectively assess the situation, one of the most authoritative is Education First (EF). Its regular current Education First English Proficiency Index (EF EPI) rating is published annually based on its own English proficiency assessment tests conducted on their website for users around the world, and in collaboration with companies to evaluate their employees [1]. For convenience and clarity of presentation, the information is summarized for some historically developed regions of Europe (Table 1).

Table 1. EF EPI rating based on reports from 2011 to 2021. Europe regions.

Region	Country	2011		2014		2017		2019		2021	
		Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
North Europe	Norway	1	69,09	5	64,33	4	67,77	3	67,93	4	632
	Sweden	4	66,26	3	67,8	2	70,4	2	68,74	7	623
	Finland	5	61,25	4	64,4	5	65,83	5	65,34	8	618
Baltic	Estonia	-	-	8	61,39	-	-	22	58,29	18	581
	Lithuania	-	-	-	-	20	57,08	17	60,11	20	579
	Latvia	-	-	12	59,43	-	-	24	56,85	22	569
South Europe	France	12	53,16	21	52,69	22	54,39	23	57,25	24	551
	Spain	17	49,01	17	57,18	21	56,06	25	55,46	25	540
	Italy	16	49,05	20	52,8	23	54,19	26	55,31	26	535
Slavic Republics	Belarus	-	-	-	-	-	-	27	52,39	28	528
	Ukraine	-	-	23	48,50	25	50,91	29	52,13	30	525
	Russia	18	45,79	22	50,44	24	52,19	28	52,14	32	511

Data for EF EPI began to be collected in 2007-2009 and the first report was published on their basis in 2011. EF publishes new reports every year and in 2020 the tenth edition was published displaying data within the updated rating system. Figure 2 shows the average rating of some European countries by region.

The tests are based on adaptive testing primarily of basic skills: reading and listening comprehension. Since they are held on the Internet and people who are more interested in mastering the language pass them, the results are somewhat overstated, and countries with weak Internet distribution drop out of the rating. Despite all this, the rating data allows us to determine trends in the further development of the situation in the world as well as prolong and extrapolate them. In addition, EF EPI has a strict (>70) correlation with TOEFL iBT and IELTS Academic Test.

According to EF, only Scandinavia and the Netherlands can say that the problem of mastering English as a second language has been solved. This success reflects decades of efforts by national ministries of education to promote multilingualism. School systems in these countries use several key strategies including early focus on communication skills, daily learning of English, both in and out of the classroom as well as specialized language training in the last years of study whether it is a vocational school or university. The EU's

robust data collection and information exchange network has helped to spread best practices among member countries.

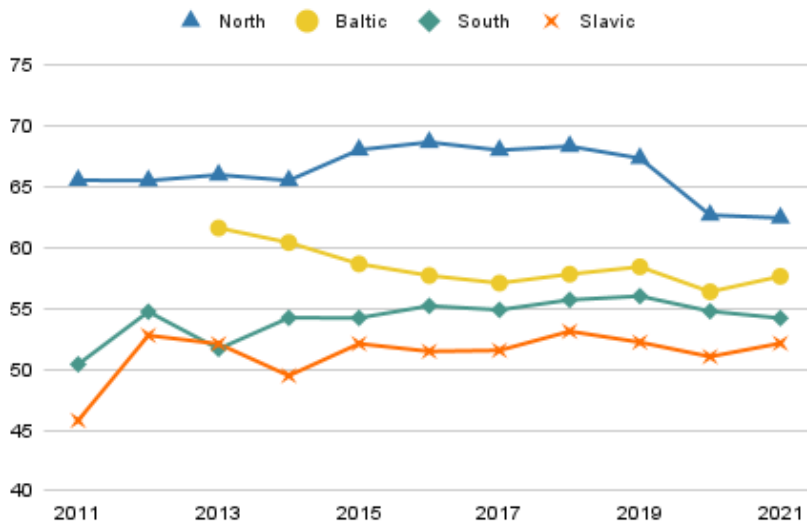


Fig. 2. EF EPI rating. Europe region.

In the Russian-speaking countries of the former Soviet Union, the level of English proficiency continues to remain steadily low. A survey conducted back in 2014 showed that 70% of Russian adults admitted they did not know a single foreign language and only 11% said they could speak a little English. English language teaching in schools focuses on grammar and translation rather than practical communication skills with most of the content being delivered in the native language. University graduates need a year or more of intensive preparatory English courses, because their English level is too low to move to a European country to get higher earnings.

Unfortunately, the situation is similar in those countries that account for the peak of emigration waves. Of the four largest economies in the eurozone, only Germany speaks English well. France, Spain and Italy lag behind almost all other Member States. The gap in English proficiency is of particular concern, as both Italy and Spain suffer from high unemployment especially among young people and are subject to a constant influx of new migrants. Of these three countries, only France has made steady progress over the past three years. According to a recent government report, at the age of 15 only a quarter of French children are able to string together several sentences in “more or less correct” English. In 2020, the next round of reforms in the field of education was announced.

A special role is assigned to the Baltic countries which have chosen English as the language of interethnic communication within the united Europe instead of Russian that has led to quite obvious consequences. On the one hand, the population has decreased, because the most motivated young people have left for English-speaking countries in search of a decent job, on the other hand the best methods of Scandinavian countries have been chosen for teaching in schools. This has led to the fact in a short time since leaving the USSR, the republics freed from educational dogmas in the EF rating turned out to be higher than those European countries where long-outdated methods of learning foreign languages have a predominant influence. Such methods are similar to the study of medieval Latin and at the same time are rigidly fixed by legislative regulations and curricula of educational systems.

Quick and easy communication strengthens ties between Europeans as well as student exchange, travel and transnational work. Even when growing nationalism or a negative

change in the political situation in the partner countries challenges EU projects, the opposing forces of European cohesion seem stable. Corporate and publicly funded adult education programs are common throughout Europe, but these foreign language courses are often too short and too low-intensity to be effective. European countries could further improve the level of English proficiency by introducing adult education which is certified externally and normalized in accordance with certification systems to ensure its quality, but this is happening too slowly.

3 E-learning of a foreign language as a mechanism for the formation of speech skills

The main direction in teaching a foreign language is the formation of a learner's untranslated command of a new language.

The poor quality of the numerous methods offered often leads a person to the misconception he is not able to master foreign languages. In fact, this is far from the case. A foreign language so necessary for professional and general personal development can be mastered qualitatively and to the extent necessary for the full realization of the personality in a new job at any age within a few months. And everything depends first of all on the proposed approach to the formation of a new language zone in the minds of adult learners.

3.1 Prerequisites for creating a language skills acquisition system

The mechanism of speaking in any language is set genetically and it cannot simply be changed. As the outstanding Russian scientist Academician Shcherba said "... it is possible to expel the native language from the learning process, but it is impossible to expel the native language from the heads of students in classroom conditions" [2]. Figure 3 shows the zones that determine the speech behavior of a person in the process of communication [3]. The Wernicke zone helps a person extract complete phrases from audible speech and then isolate the meaning from these phrases. Understanding of the sounding speech in a person's mind occurs automatically and no logical reflection is needed here. A person hears a speech and he understands its meaning. The second brain structure is the Broca's area. It is responsible for speech reproduction. When a person speaks it is enough for him to think and the reproduction of thought occurs through the Broca's zone which forms meaningful speaking.

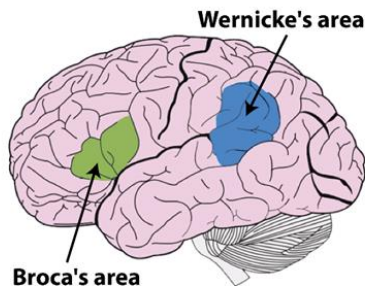


Fig. 3. Zones of speech behavior.

These brain structures have no conscious control and a person cannot spontaneously speak a foreign language. A person can realize that he is speaking a new language if he hears speech immediately understand it (Wernicke's zone works) and he does not need to strain to express thoughts (Broca's zone works). Thus, the minimum element for understanding the

language is dialogue and highly qualified linguists combine all this in one phrase "You know the language if you think in it."

Unfortunately, things that are obvious to psychologists do not find their embodiment in the traditional practice of teaching foreign languages, and only the most trained specialists with special techniques are able to significantly reduce the duration of training not only without compromising the quality of training, but on the contrary guarantee it.

To realize this, it is necessary to immerse the cognitive system of the language to be acquired into the consciousness of the learner. No "magic" electronic innovations will make it possible to create an effective system of teaching a new language if the principles of its functioning are not based on the fundamental mechanisms for the formation of speech skills. The theoretical foundations of such a psycholinguistic approach were developed in the XX century by outstanding scientists in various fields of cognition.

In the third decade of the XXI century, both methodological and new technological prerequisites have matured. Technologies and tools created under their influence are directly influenced by a changing culture, and their further use is a way of accumulating and transmitting social knowledge.

Technologies using Big Data, artificial intelligence, machine learning, speech recognition and synthesis systems as well as augmented or virtual reality create the technological basis that forms the base for the creation of new LMS. In turn, Korzybsky's structural differential, Leontiev's theory of activity and his followers, the system of interval repetitions based on the ideas of Ebbinghaus, the theory of Bandura skills formation and the Structural and Visual Method (SVM) form the core of the electronic system for acquiring language skills (e-AMS).

A special role is played by the introduction of teaching methods that use new channels not only for obtaining information about a new language, but above all opening up opportunities for the formation of stable foreign language acquisition skills. As the study of existing technological prototypes has shown, at the moment there are no programs that allow you to block thinking in your native language and guarantee quick acquisition of direct thinking skills in another. Such a goal has never been realized, but it has not even been set.

3.2 Structural and Visual Method and Visual Models of language

The processes of human information exchange with the environment as well as human communication using language including sensory and motor mechanisms as a subsystem are insufficiently studied and formalized. There are many hypotheses and models often mutually exclusive and contradictory and even more different interpretations and names of elements of the language system.

The language has its own complex hierarchical structure, the number of levels in which is much more than the generally accepted division into phonetics-vocabulary-grammar (sounds-words-sentences in Figure 4). For most people, instead of a speech mechanism, a translation mechanism works, introduced by the school approach to language learning, which is physiologically another process, the opposite of language. To launch the speech mechanism, it is necessary to create a database of sound images, speech-motor images and direct connections of these images with meanings (speech operations and speech actions).

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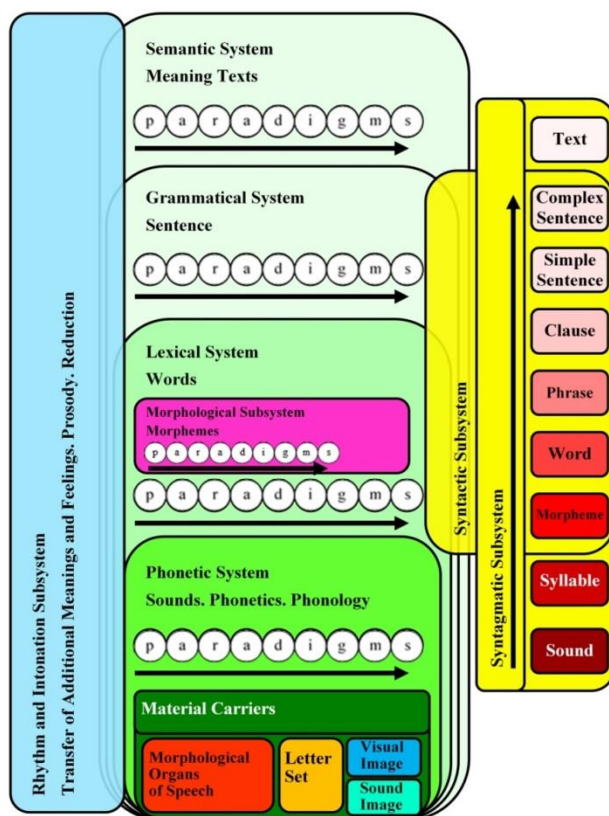


Fig. 4. Hierarchical structure of the language.

The Structural and Visual Method allows getting out of this contradiction replacing complex textual rules with corresponding visual structures in the form of drawings, schemes and diagrams. The application of SVM in linguistics consists in the use of graphic means to demonstrate the structure of an English sentence and ways of constructing it in various forms with extensive use of color for encoding meanings. The method reveals the mechanisms of practical use of both visualizations of the first kind which include visual dictionaries and virtual classes, and visualizations of the second kind embodied in Visual Models [6] for different levels of foreign language acquisition.

In the future, the formed set of grammatical constructions is transformed into Visual Models of the appropriate level with such assumptions when the illustrative material is correlated with a specific task of mastering professional material, with specific educational actions. Then teachers know exactly what the introduction of visibility is necessary for in each particular case, and they submit Visual Models exactly in the form in which they can best perform the corresponding professional task.

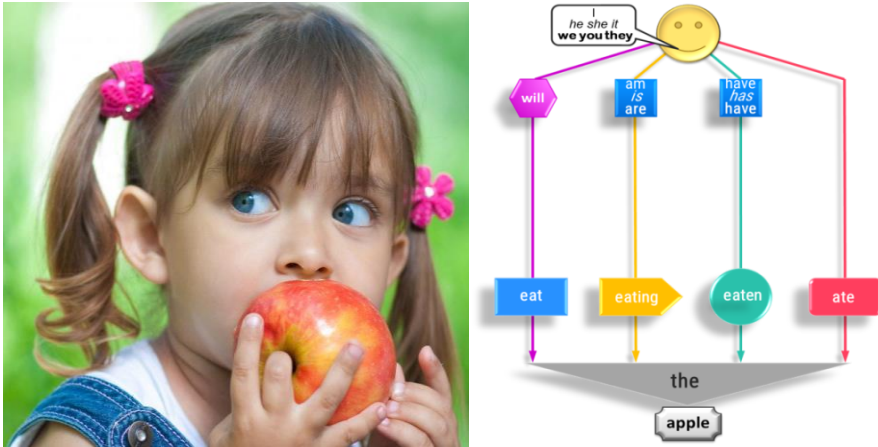
If you show a student of any age and any nationality what to talk about and how to build a sentence (Figure 5), they will be able to do it! These illustrations in fact do not need words.

The basic idea of visual models is as follows:

students should immediately know how to speak, how to think, how to communicate;

teachers, with appropriate training and the availability of materials, can remotely demonstrate almost everything on video, "talking" pictures and self-learning schemes, ideally refusing to use a "live" language when explaining the material;

at the same time, the electronic system must continuously monitor the correctness of the students' learning process in terms of semantics and pronunciation.



What to speak about

How to speak

Fig. 5. How to build a sentence and what to speak about.

The following two models (Figure 6) show how simply in accordance with the logic of English speech affirmative sentences are transformed into negative ones and general questions are constructed.

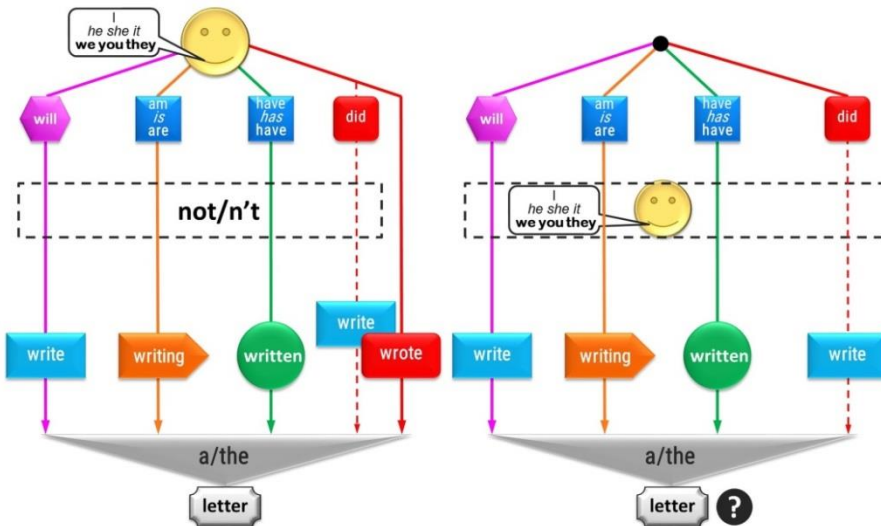


Fig. 6. Visual Models of the structure of negative sentences and general questions.

And so on according to the degree of complexity of the acquired material within the chosen field of activity. Models designed to describe the stages of development of elementary processes can be conveniently summarized in the Basic Model (Figure 7). It includes all the previous variants which can easily be represented by its visual transformation.

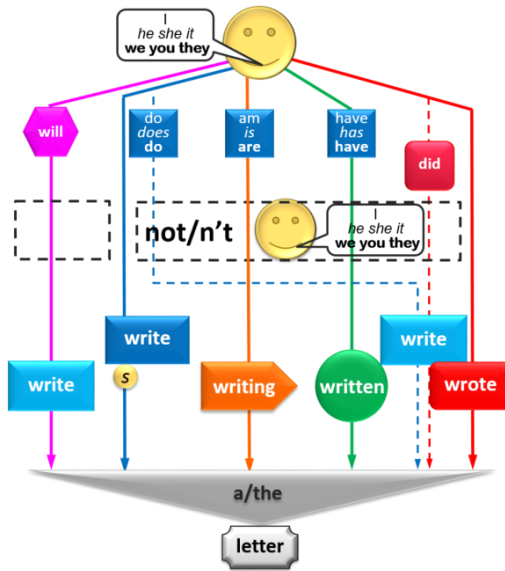


Fig. 7. Basic model of the English sentence.

Attempts to create language models and use the principles of visibility for teaching a foreign language have existed before. But the visualization of the utterance structure did not go further than Chomsky's generative grammar [7] with its trees understandable only to a narrow circle of specialists, and formal tables that have been roaming from textbook to textbook for decades. There was also a rather successful attempt: to demonstrate the evolution of approaches to teaching English Grammar, we significantly corrected the table of English "tenses". In Table 2, the most frequent "times" are highlighted, their color identification is introduced and simple examples are added. But even such a table is a "naked" spatial scheme, still conveys mainly information about the language and weakly correlates with the task of forming a speaking zone in a new language. Thus, this is nothing more than the visibility of the first kind.

Leontiev defined visualizations of the second kind as "an external support of internal actions" [5]. It should be noted we are talking about the conscious sequential formation of the speech zone of a new language and the implementation of foreign language communication each time at a slightly higher or comparable to the previous level of complexity. And each time the subject of awareness (and further reflection in speech) is a communicative situation perceived through the prism of both the subject area and the grammatical and semantic system of the acquired language. This visibility acts as a support (basis) for the assimilation of the material which later turns out to be unnecessary, because the corresponding speech operations are switched to the plans of "mental actions", automated, become unconscious and are included in the composition of speech actions as a new psychological whole.

The second kind of visibility is used in both situations of formation and speech operations and speech actions. In the latter case, visibility correlates either with the content side of speech actions (modeling of a real communicative situation is performed) or with the patterns of speech utterance (that is, with the structure of speech action). Here as in the formation of speech operations one or another component is temporarily included in the "light field of consciousness", then it is automated and passes into the subconscious. But the level of awareness is already different than in the case of operations. It is in this way that grammatical constructions of a new language inevitably pass from the form of passive understanding into the active form of their automatic use.

Table 2. English "Times" with examples.

<p>Future Simple (will) + (verb) (am / is / are) + (going to) + (verb)</p> <p>WILL (WON'T)</p> <p>You will study English in the future. You are going to study English in the future.</p>	<p>Present Simple (verb) + (s or es – if using the 3rd person)</p> <p>You study English every day. She studies English.</p> <p>He, she, it + Vs (-es) "not" DOES I, you, we, they + V "not" DO</p>	<p>Past Simple (verb) + (ed) or irregular</p> <p>Regular V - ed "not" DID Irregular V - 2f. (to infinitive)</p> <p>You studied English yesterday.</p>
<p>Future Continuous (will) + (be) + (present participle) (am / is / are) + (going to) + (be) + (present participle)</p> <p>WILL + BE + Ving</p> <p>You will be studying English for the next two years. You are going to be studying English for the next two years.</p>	<p>Present Continuous (am/is/are) + (present participle)</p> <p>You are studying English right now.</p> <p>I, he, she, it - AM He, she, it - IS +Ving You, we, they - ARE</p>	<p>Past Continuous (was / were) + (present participle)</p> <p>I, he, she, it - WAS You, we, they - WERE + Ving</p> <p>You were studying English when the telephone rang.</p>
<p>Future Perfect (will) + (have) + (present participle) (am / is / are) + (going to) + (have) + (present participle)</p> <p>WILL + HAVE + V (ed) 3f.</p> <p>You will have studied English for two years at some time in 2012. You are going to have studied English for two years at some time in 2012.</p>	<p>Present Perfect (has / have) + (past participle)</p> <p>He, she, it - HAS I, you, we, they - HAVE + V(ed) 3f.</p> <p>You have studied English at some time in the past.</p>	<p>Past Perfect (had) + (present participle)</p> <p>HAD + V(ed) 3f.</p> <p>You had studied English at some point in time before you came to class.</p>
<p>Future Perfect Contin. (will) + (have) + (been) + (present participle) (am / is / are) + (going to) + (have) + (been) + (present participle)</p> <p>WILL + HAVE + BEEN + Ving</p> <p>You will have been studying English for two years next Monday. You are going to have been studying English for two years next Monday.</p>	<p>Present Perfect Contin. (has / have) + (been) + (present participle)</p> <p>He, she, it - HAS I, you, we, they - HAVE + BEEN + Ving</p> <p>You have been studying English for three years and you may continue studying English.</p>	<p>Past Perfect Contin. (had) + (been) + (present participle)</p> <p>HAD + BEEN + Ving</p> <p>You had been studying English for two years before you came to class.</p>

The views of linguists on the number of types of modern forms of the English language do not always coincide: most often they adhere to the variant with 26 types of modern forms. All of them are presented on a Complete Model of the structure of English Grammar (Figure 8). The complete Model makes it easy to understand the principle of constructing not only the types of modern forms of passive and active pledges, but also modal constructions, conditional sentences, etc. Their meanings and usage situations are described in detail in the educational literature, but they are all divorced from professional activity and practically have no visual equivalents.

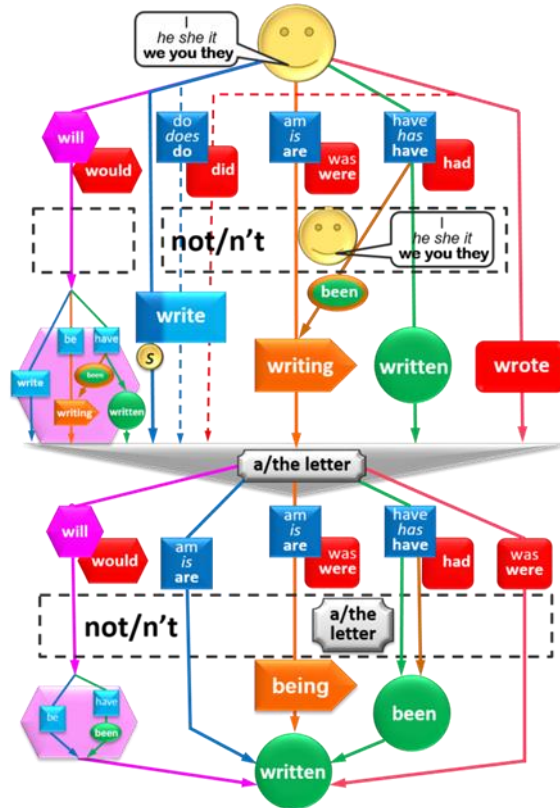


Fig. 8. Complete Model of the structure of English grammar.

Currently, a functionally complete set of Visual Models for English has been developed as well as preliminary prototypes of models for Spanish, Russian, German and French. Such tools for describing the grammar of a foreign language should be in every linguistic class, then sometimes just a thoughtful glance is enough to understand the structure of the language and a new sentence will be formulated quickly and accurately. The subsequent training of professional skills will allow you to consolidate and transform the consistently formed fundamental grammatical skills into solid skills of speaking a new language in the form of a conscious utterance or dialogue. In terms of their significance, Visual Models can be compared with the periodic table of chemical elements which hangs on the wall in any classroom where chemistry classes are held.

Without basic grammatical skills, the same communicative approach turns into a simple memorization of spoken phrases. Visual structures of the construction of an English sentence allow for conscious practice, that is, independent planning of the utterance and control of its correctness. It is proposed first of all to focus on mastering the system of English "tenses" and automation skills, and to postpone the variety of communicative situations for subsequent practice. If you work out the basic construction on a limited amount of vocabulary to full automatism, then their use in the future will not cause difficulties and will not require conscious control according to the rules. Language acquisition is much faster if there are ready-made algorithms with which the language "works" than when trying to independently derive these algorithms from the speech flow and communicative situations.

The choice of the optimal mode of teaching grammar skills is complicated by the lack of a mathematical description of the regularities of this process, the almost complete lack of accurate data and available means of obtaining them. This is due to the extreme complexity

and multilevel structure of the language, which is a fractal system with a huge number of interrelated variables, mathematically not strict and ambiguous. It is proposed to choose a very simplified model from this system, formalize it with the help of system analysis tools and obtain statistical data within this model. Such data will allow us to identify the necessary patterns, analyze them, and use the data obtained to improve the effectiveness of training and expand the initial model to the level required in specific cases.

Two modes are necessary for successful conscious training: linear demonstration of patterns for their implementation and random training for full automation of the skill. The first mode shows a linear change of one parameter with fixed other variables. When using the second mode, linear and random changes of these parameters can be combined to create unpredictable situations that require real thinking using language to complete the task.

Replacing verbal rules with Visual Models makes it possible to make significant improvements to any teaching method. Instead of hindering language activity, SVM makes it possible to consciously manage the training of professional skills and very accurately control the process of forming language skills. This removes the acquisition-learning contradiction and turns the grammar monitor into a grammar scaffold. Visual models allow you to quickly launch the speech mechanism and provide not only a comprehensive input, but also a comprehensive output which in Krashen's theory [8] rightly seemed ineffective.

Visual Models can be used as an independent tool that allows you to bring "correct speaking" into everyday speech activity, but its use in interactive speech simulators as part of e-AMS seems to be the most effective.

4 Conclusions

The use of modern information technologies in combination with the use of effective models of skill acquisition makes it possible to reduce or even completely eliminate the influence of various psychological obstacles. This of course accelerates the learning process and increases its success by transferring a synergetic effect to all stages of the formation of professional and language skills which is especially important in the process of acquiring a foreign language.

In our opinion, such a visual approach to learning should be considered as a kind of new direction in the development of e-learning. It is proposed to put into practice a model of integrated professional and language training using ICT. And without going beyond the already established taxonomy on the use of digital technologies in teaching ascending to the abbreviations CALL (Computer assisted language learning) and CLIL (Content and language integrated learning) replace the vague definition of ESP (English for specific purposes) with a new abbreviation PLIL (Professional and language integrated learning).

The main result today can be considered a conceptual solution to the problem of simultaneous interaction of the language system and ICT tools that ensure the sustainable formation of foreign-language thinking of adults in the process of developing professional and language skills presented at the system level.

References

1. Education First English, Proficiency Index. *EF EPI. The world's largest ranking of countries and regions by English skills* (2021), <https://www.ef.com/wwen/epi/>
2. L. Scherba, *Language system and speech activity* (Science, 1974)
3. A. Flinker, A. Korzeniewska, A. Shestyuk, P. Franaszczuk, N. Dronkers, R. Knight, N. Crone, *Proceedings of the National Academy of Sciences* **112**, 9, 2871 (2015)

4. A. Bandura, R. H. Walters, *Social learning and personality development* (Holt, Rinehart, & Winston, 1963)
5. A. A. Leontiev, *Language and speech activity in general and pedagogical psychology* (Moscow Psychological and Social Institute, 2004)
6. I. Tahini, T. Nakayama, V. Dibrova, A. Dadykin, *IJSSH*, **8(4)**, 110 (2018)
7. N. Chomsky, *IRE Transactions on Information Theory*, **2(3)**, 113 (1956)
8. S. Krashen, *Principles and Practice in Second Language Acquisition* (University of Southern California, 1982)