

Control System of Foreign Language Training Based on Structural-Visual Techniques

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Abstract—Modern complex projects in the field of education require the joint efforts of specialists from different fields of science and technology. Differences in terminology, methodology and language create significant difficulties and obstacles in coordinating these efforts. We need new forms of cooperation in order to integrate the achievements of scientific and technological revolution and computer information technologies, constructively combine existing technical capabilities with the developments in the field of humanities. This requires another universal language to describe the subject areas, used tools and the methods of organization and coordination of complex interdisciplinary projects. This work is aimed at finding new ways to improve communication and understanding, as well as new ways of learning and skills training, mainly for adult learners. The use of visual approach and the visual model which is based on this approach and the use of the tools of systems analysis and IT-technology provide new encouraging results. Current research has led to the development of conceptual solution in the form of the training system that allows to control the process of formation of language and work skills of adults.

Index Terms—Learning Management System, Structural Visual Method, Visual Model.

I. INTRODUCTION

Recent events have put in front of humanity new tasks that cannot be solved in old ways. Globalization and migration crisis make this question especially important and challenging. Moving a large numbers of people from one country to another requires their education and socialization, which is practically not feasible in the traditional education system, which was created long ago on a very different purpose.

At the same time, the development of alternative ways of learning using new opportunities has emerged leading to rapid growth in computer and online learning. There are many companies and start-ups, creating programs, applications and services for training, educational process management and its organization. The products developed are good enough to cope with the automation of routine processes of knowledge transfer in the field of theoretical training. But in practical skills training, including language training, there was a little progress due to objective reasons.

These complex interdisciplinary developments require coordinated work of specialists in various branches of knowledge, use of different terminology, methodology and model of the subject field. It is extremely difficult to work together and it leads to the fact that in the latest technical systems implemented outdated methods, and teachers are not using the technological capacities of modern systems insufficiently, and Methodists do not put into practice scientific discoveries and developments.

The proposed Structural-Visual method [1, 2] offers a new approach for the harmonization of terminology in interdisciplinary projects, and can be used to create new tools of learning skills and foreign languages. The essence of the approach is structured knowledge and translating information about the laws of the subject field into a visual form. Development of visual meta-language to non-verbal communication with the teacher-student systems, human-computer and human-human can help improve facilities for training and create a new generation of LMS.

II. THE URGENCY FOR DEVELOPING A NEW GENERATION OF EDUCATIONAL SYSTEMS

According to the analysis of the minimal model of the human psyche [3], there are several human learning pathways skills of some activities, and the classical conscious way is most commonly used (through verbal explanation and study of the rules), modeling the way (imitation or simulation) and the path of trial and error. In various fields they exist under different names. In the field of teaching foreign languages there is a greater diversity of methods and their names. But if we ignore the complexity of terminology and work with a visual model of the subject industry, they all boil down to the combination of these three ways.

Psychological science has done a lot in the 20th century for the study of human activity, and finding regularities obtaining skills of its implementation (Skinner [4], Bandura [5], Leontiev [6], Galperin [7] etc.). The data obtained allowed to develop the detailed theory sufficiently and on its basis to create a system of accelerated training specialists in specific

branches (the army, intelligence services, some areas of production and technology, large corporations). But the closeness of these areas and the low level of interest in the dissemination of this experience led to the fact that the research and development are not known to the vast majority of professionals involved in the development of similar systems in other sectors and countries. This forces them to use outdated, inefficient models and approaches developed for entirely different conditions and problems in pedagogy and applied by virtue of a very big conservatism of the state educational institutions.

Increased migration posed very serious task of accelerating the human process of preparation of the activities, including language, improving the quality of training while reducing training costs. The subject of accelerating learning skills, particularly language, is important for both those who work in the field of education and training and people who are to get adapted to a new environment (they need lots of new skills and, above all, a foreign language). The complexity of solving this problem in a limited time, in spite of enormous efforts that is applied, by the people themselves, and countries hosting them, leads to the fact that people lose the motivation to learn, are not included in social life, cannot find jobs, closed in its range and are easy to be influenced by destructive forces. Therefore, the creation of an automated system fast and effective teaching another language at minimal cost is very important and very urgent. Especially because all the elements necessary for development of such a system are already available. There is no only mutual understanding between representatives of different fields of activity due to the linguistic and terminological differences. Structural and visual approach allows these difficulties to reduce or eliminate.

III. ANALYSIS OF THE CURRENT SITUATION AND EXISTING PROTOTYPES

Since the scope of online learning is booming, there are plenty of offers on the market. These Learning Management Systems (LMS) are of the general type, Apps for learning languages, for certain aspects of the language, and the whole language as a system. In the context of the project a large number of programs, applications and services were researched and tested. Therefore, we focus only on common features of the whole classes of programs and services, mentioning only the most common examples.

LMS general type, such as Moodle, Docebo, Edmodo, Schoology and many others, are created for the organization of educational process in the framework of the classical way of learning. They are designed to facilitate and simplify the work of the teacher, in teaching methods, management of the institution and contain a huge number of features, functions and tools. They are complex to set up and learn and are designed for use within large organizations (schools, universities, large companies). Their functions are fulfilled properly, but to adapt them to control the process of getting a

specific individual skill is extremely problematic.

Due to low methodological competence of programmers in most cases the specialized programs are created for learning words. The use of spaced repetition methods in such programs and services as the Memrise, Mnemosyne, Anki, Supermemo etc., allow you to memorize quickly poorly structured information than provoke users to spend a lot of time on a completely unproductive activity on memorizing and translating words out of context and structure. The majority of services and social networks for language training, such as Duolingo, Busuu, LinguaLeo and others face the same mistake.

The closest prototype are programs for comprehensive study of a language such as Rosetta Stone, Tell Me More, Babbel, etc. They offer tools for the development of most language skills and are designed more for self-study.

These programs do a good job with its functions by virtue of their inherent in the basis of direct method. But it has its own limitations and shortcomings, delaying the progress and forcing people to give lessons. Chief among them - the same direct method that reduces the exercises to repeated repetition without understanding the logic of language operation. As mentioned above, a conscious exercise is more efficient, and skewed toward practices without understanding the theory can be inefficient as well as studying theory without applying it in practice. In addition, the programs are not able to adapt to the individual characteristics of the student, his native language, and the way of thinking. Therefore, the pace of learning offered by the program, will rarely match the abilities and capabilities of the student, or will lead to boredom or excessive stress. And conclusions made by the pupil based on limited amount of examples about the structure of grammar can be very original and very far from the real situation.

The situation is exacerbated by the complexity and congestion of the interface, the non-obviousness of the training of technique and relatively high cost of such programs. Such programs are created by programmers for people fluent in computers, and are ill-suited for use by ordinary people, a little familiar with computer technology.

In addition, the presence or absence of the native language in the interface and the content of the program does not guarantee the absence of translation of thought and deliberation of the material in their own language, especially for people who have already had many years of experience in the transfer of learning. In the words of a prominent Russian scientist, Academician LV Szczerba, "we can expel the native language from the class, but not from the head of the child" [8].

To achieve direct understanding without translating is only possible by a perfect balancing the complexity and pace of a workout with the abilities and capabilities of the student, by controlling the learning curve, which is the most important task of this development. As shown by the study of the existing prototypes, at the moment there are no programs to block the way of thinking in their native language and to

ensure prompt receipt of direct thinking skills on the other. Such a goal is not only not implemented, but not even it is put. There are no courses, textbooks and curricula, learning how not to think in your native language.

IV. METHODOLOGICAL AND ONTOLOGICAL DIFFICULTY OF MAKING QUICK LEARNING SKILLS NECESSARY TO AN EFFECTIVE SYSTEM

The problem of rapid training of a large number of people in another language exists for a long time, and on this topic conducted a lot of research and a lot of theories, methods and techniques. Unfortunately, because of increasingly narrow specialization in science, these studies take place within a rather narrow paradigm of science definition that resembles an elephant blind study of the well-known parable. As part of these paradigms is not possible to see the limitations of the approach, and to find new ways to solve this problem. In the field of language learning difficulties are increased many times by virtue of the complexity of the object of study, and because of violations of this approach the laws of structure of activity [6] and 2nd Gödel's incompleteness theorems [9]. Language is a tool for thought and communication, and the use of natural language for study, training and language learning leads to a structural mismatch, logical closure and psychological and physiological problems.

In language study, language is the subject of research, and at the same time a research tool that is methodically wrong. But researchers thinking occurs in their native language, and the structure of the grammar of this language inevitably mediates method and structure of their thinking. Therefore, language implicitly is also a method of investigation. The result of the research is usually a scientific publication, which is a text in the same language. Thus, when thinking of language study, language activities and language teaching methods are both the subject of activity, tool operations, process activities and results of operations. What cannot but lead to confusion is inconsistencies and unnecessary complexity of the expense of logical operations. To eliminate this confusion, it was proposed to make a description of the structure of language from the scope of the same language and to use the Visual Meta-language. The same information about the structure and laws of the processes is encoded not by words and terms, but by the parameters of abstract visual objects and shapes - color, shape, size, relative position, boundaries, etc., as well as special visual signs and symbols.

Proved particularly productive use of this approach is to explain the structure of the target language to learners and principles of sentence construction. As is known, self-conscious practice significantly (up to 10 times) more effectively mechanically and repetition copy. This has been confirmed in studies and is the basis of the theory of successive formation of mental actions of P. Galperin and developed on the basis of its practical development techniques skills in different fields of activity [7, 10]. But in the field of language learning, this approach does not work due to the

above contradictions - the language must also be the subject of educational activity, and the tool of this activity, and the way these activities, and the result of this activity. If the student does not know how to express the idea and create a phrase in the target language, he mainly cannot do this because of his ignorance and illiteracy. But if he obtains all the necessary knowledge how to do it using rules and terms, he still cannot do this due to the fact that the speech area of the brain, that must implement the act of speaking, is occupied the language as information on how to implement this activity.

The proposed visual approach to coding grammatical information allows you to transfer an indicative basis for activities, information on how to perform this operation correctly, from the language, verbal forms in the visual, visual. Freeing this speech area from the planning and control functions of expression and creating the conditions for an easy and smooth implementation of speech activity. Language activity by itself is meaningless. Language is a tool for thought and communication, and to function properly in such activities. Therefore, the study of language as an end in itself, too, is not justified and logical. It is necessary to educate not language, and activities through the language, that is, thinking and communication. This is proposed in the documents of the Council of Europe [11] as a competence-based approach and the communicative method.

Developed within the framework of this research project a process control system for obtaining language skills designed to implement such a visual approach in the form of separate programs, applications, and an integrated system for maximum ease, simplify and automate this process. It is necessary to create a new generation of educational process management tools that provide not only the structuring and transfer of knowledge from teacher to pupil, but also the quantitative and qualitative level management skills and student competencies and the parameters of its real progress on the learning curve. This is especially important in the field of training and retraining of A. Bandura [5], learning occurs in the interaction between the environment, human behavior and properties of his personality. At the same time the influence of previous experience leads to the fact that the learning curve instead usual logarithmic growth becomes distorted with several minimum points, so-called "barriers to overcome" (Fig. 1).

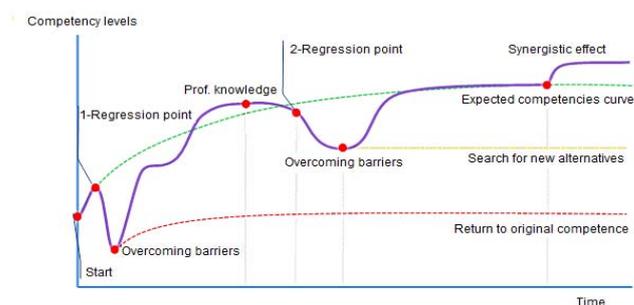


Fig. 1. Relearning curve

The use of modern IT-technology in conjunction with the use of effective models for acquiring skills allows to reduce or even completely eliminate the impact of these barriers and thus accelerate training and enhance their success. A modern system analysis tools and visual modeling proposed in this study will help to ensure this integration. They can effectively align the ontology in the domain field in terms of very different sectors of human activity, each with its own terminology, methodology and established paradigm. To ensure adaptability of the learning process and improve its efficiency, it is necessary to use the most modern technologies, such as cloud services, voice and voice technologies, powerful mobile computing devices, high-speed communication lines, allowing to work with multimedia content in real time. These devices and technology have appeared or have reached the desired settings recently, so a new generation of the system could not be developed before the creation of the preconditions for this. At the moment, there are no technical limitations to create systems of new generation, but only the difficulty in combining in one project knowledge, theories and technologies from different industries and science does not allow you to connect already available solutions in the new method proposed in this study.

V. MODELS OF LANGUAGE TEACHING

Providing non-verbal tools for teaching foreign languages, new ways of doing and new social interaction and communication is a very promising direction and opens new horizons for the development of effective ways to resolve these problems.

The proposed approach allows you to:

- a) *Separate* the structure of knowledge of the language from the words,
- b) *Move* the meaning into the intermediate sign system in the form of visual models,
- c) *Then say* the same meanings in the target language.

With this as a rough basis of speech activity verbal rules are not used, and the visual structure is called "LingvoMap".

A simple example is shown in Fig. 2 - LingvoMap. It shows the way of construction of a simple declarative sentence in English for the aspectual-temporal forms, corresponding to the stages of development of a single event in time.

The model for the interrogative sentence is shown in Fig. 3. In this case, the subject moves to the place after the service verb. Grammatical transformations are shown graphically, without words. This allows the student not to think on using the rules of the native language, but directly creates the correct English sentence, based on the visual structure.

In process of mastery of a student, the show model form is changed and becomes more complicated, adapting to the volume of material chosen for the explanation on a particular lesson.

In Fig.4 shows a model of all temporary forms for simple sentences, to understanding where the student comes as a

result of mastering the intermediate models.

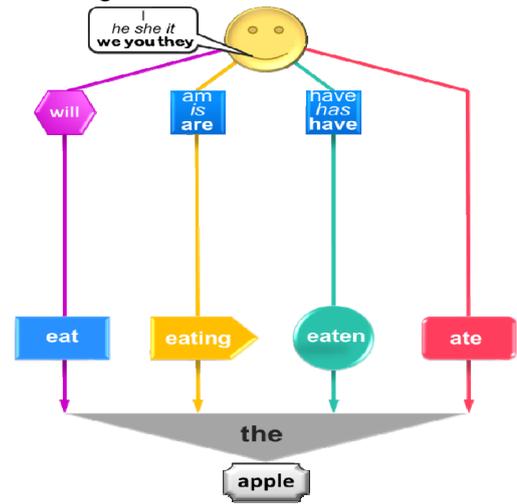


Fig.2. Model structure of declarative sentence

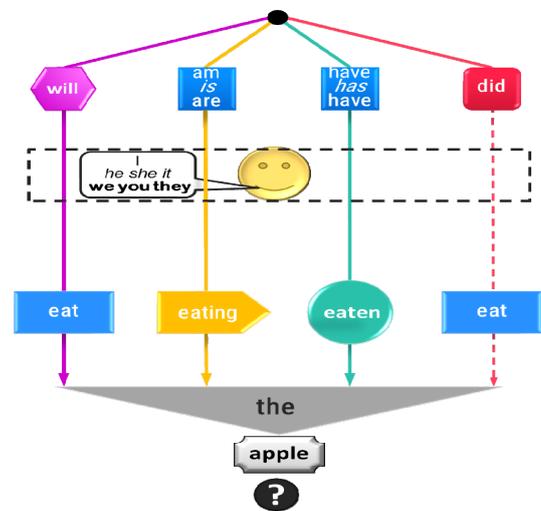


Fig.3. Interrogative sentence model

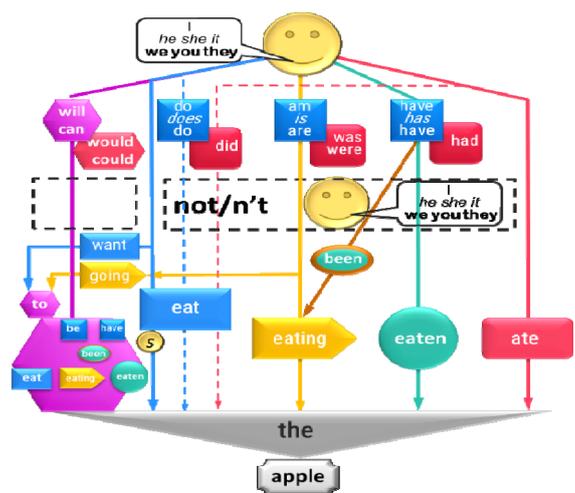


Fig.4. The full model for all temporary forms

To date, we have the full set of visual models of the major structures of the English language, as well as pre-sets for the Russian and French languages. Visual models were used to teach Russian-speaking students to use English tenses of the verb. Online training was held by more than 300 students, mostly adults. The format of the training did not allow obtaining accurate quantitative results, but positive feedback from the majority of students indicates its undoubtedly benefits and prospects. Models were used mainly in the form of paper printouts and PDF files. Even in such a simple format, the method showed efficiency and usefulness. Development of interactive simulators with the use of speech and voice technologies can significantly increase the effectiveness of the application of the Structural-Visual method. The organization of material in the form of LMS of a new type will allow to measure and monitor the individual learning curve of each student and create optimal conditions for accelerated obtaining of necessary skills.

VI. PRINCIPLES OF BUILDING A SYSTEM TO CONTROL THE PROCESS OF MASTERING THE LANGUAGE

The basis for the harmonization of terminology, methods, procedures and structures in the process of creating a new generation of LMS is a visual meta-language tools and systems analysis, as a link between theory and practice, IT and humanities field, science and social processes (Fig. 5).

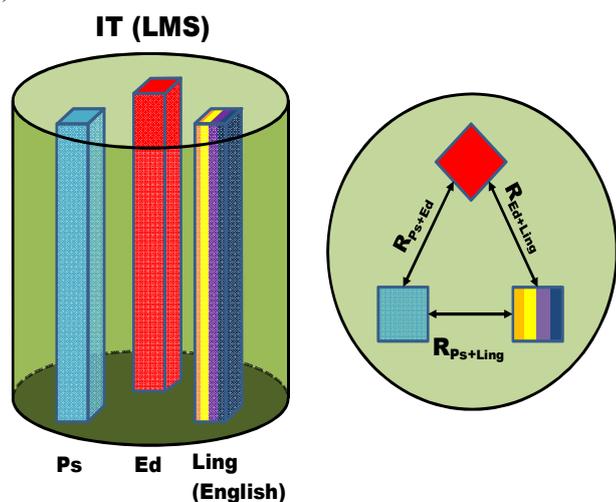


Fig 5. Structural diagram of LMS (upper level of abstraction),

where: Ed - Education; Ps - Psychologic; Ling - Linguistic

The authors recommend a conceptual solution in the form of the training system that allows to control the process of formation of language and work skills of adults.

This system combines:

- a) Methodical principles, grounded in the works of A. Bandura [5] and P. Galperin [7];
- b) The Visual Models, that creating a synergetic effect,

both in the initial phase of mastering a foreign language, and at the stage of "barrier to overcome";

c) The use of the achievements of the IT industry as a tool for ensuring the implementation of learning objectives with continuous monitoring of the current status and receiving the guaranteed result of training in a finite number of steps.

This training system has the properties:

a) The unity of the main goal of learning outcomes for all its elements;

b) High stability of the entire system and the independent value of each element;

c) Correlation between the elements of the system, providing positive feedback in the process of formation of professional and language skills;

d) Properties of continuous assessment of the student's level of competence that allows the formation of logarithmic learning curve and compensates for background learning curve degradation towards an expected loss of competence;

e) The ability to evaluate and compare the results of a similar educational systems and technologies as well as their individual components;

f) Platform-independent of any operating systems and programming languages, and invariant to the native language of the student and to the learning languages.

LMS Generalized structure of the new generation is shown in Fig. 6.

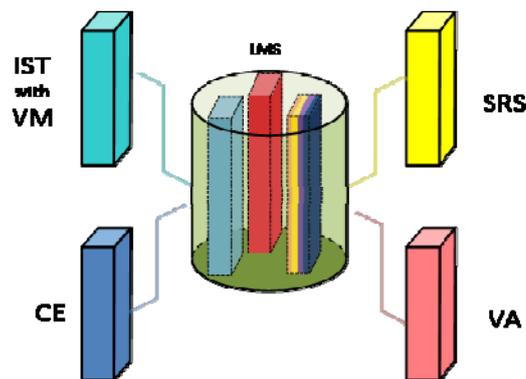


Fig. 6. LMS Generalized structure

where: IST with VM (Interactive Speech Trainers with Visual Models),

SRS (Speech Recognition System), CE (Continuous Evaluation),

VA (Virtual Assistant).

LMS simulation (Fig. 7) is an integration of the LMS components and it is a multi-model simulation software which simulates and optimizes the performance of learner to speak, listen and learn the words from the structure of the model. This type of simulation allows to quickly memorize structured information and learn the principle of sentence construction. We need to accumulate experiences by using the LMS simulation which will help the technical teams to:

- a) *Develop* simulation models.
- b) *Optimize* designs before construct any new version.
- c) *Accurately detect* weak spots.
- d) *Efficiently explore* multiple design alternatives.

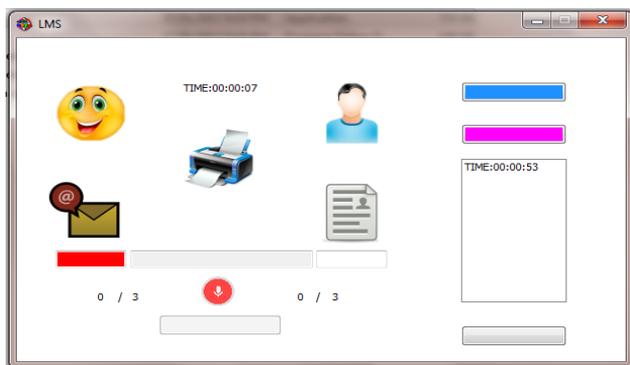


Fig.7. Interface of IST

VII. CONCLUSION

Currently, a new generation of LMS under development, which will provide a quick solution to the problem of learning languages and professional skills for a large number of adults.

This system has the following basic components:

a) Structural-visual method (SVM), modeling the structure of developing activities. The basis of the method is the Visual models;

b) Interactive Speech Trainers, corresponding to different levels of competency of students;

c) The subsystem of Continuous Evaluation (CE) and control of training process in a real time.

LMS will provide a teacher-friendly mechanism for the synthesis of teaching materials and a statistical analysis of the results of each exercise.

SVM has already been successfully used to train a fairly large number of students. Subjective reports indicate a significant acceleration of the learning process of basic grammatical structures, but the incompleteness of the development of the subsystem of Continuous Evaluation (CE) has not yet allowed to measure these results quantitatively.

There are working prototypes of simulators for some grammatical themes of the English language, active work is being done on their improvement and expansion. This requires

substantial assistance from linguists and methodologists in filling the system with content in the form of various training materials for increasing levels of competence.

LMS is created by a modular principle, therefore each element of the system can be used effectively enough separately. At the same time, the synergistic effect from the joint use of all elements of the system and the integration of additional developments can significantly exceed the capabilities of existing analogues and help solve a very important social problem. Including tasks of language adaptation and training of professional skills of refugees and migrants.

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