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REVIEW ARTICLE

Technology for determining non-humanities university students' cognitive-and-psychological characteristics

Nadezhda I. Chernova[@], Ekaterina A. Ivanova, Nadezhda B. Bogush,
Nataliya V. Katakhova

MIREA – Russian Technological University, Moscow, 119454 Russia

[@] Corresponding author, e-mail: chernova@mirea.ru

Abstract

Objectives. The purpose of this work was to create a special entrance test for first-year students starting to learn a new foreign language. To achieve the research objective, the study analyzed data on testing language/linguistic proficiency and motivation for learning a foreign language. A range of test parameters identifying both abilities and motivation to learn a foreign language in general, but not related to learning a specific language, were highlighted. The identified parameters were used to inform a questionnaire tested on a group of students, whose level of abilities and motivation had already been ascertained. The findings about students were compared with the already known empirical data to support the improvement of test items.

Methods. To describe a special entrance test for first-year students starting to learn a new foreign language in a non-humanities higher education institution, a test technology for identifying certain cognitive, psychological, intellectual, motivational characteristics of a student's language personality was created. The developed test parameters served as the basis for constructing several heterogeneous test blocks.

Results. The initial version of the test obtained was verified by pilot testing first-semester-first-year students. Expert assessments of the foreign language potential learning on the part of students were used to evaluate the reliability and validity of the test. A subsequent correction of tasks and responses was carried out in light of the verification results.

Conclusions. A recommendation to conduct this kind of testing prior to the first semester with the aim of forecasting the success of foreign-language educational activities of students enrolled in the foreign language study group from the "starter" level is formulated. The results of such diagnostics can be used to draw up personified adaptive training programs within the educational process.

Keywords: testing, entrance test, learning a foreign language from scratch, language skills, abilities

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НАУЧНАЯ СТАТЬЯ

Технология определения когнитивно-психологических особенностей студентов негуманитарного вуза

Н.И. Чернова[@], Е.А. Иванова, Н.Б. Богущ, Н.В. Катахова

МИРЭА – Российский технологический университет, Москва, 119454 Россия

[@] Автор для переписки, e-mail: chernova@mirea.ru

Резюме

Цель. Цель исследования – разработка специального входного теста для студентов-первокурсников, начинающих изучать новый для них иностранный язык. Для достижения этой цели был проведен анализ научных работ по проблемам, касающимся тестирования языковых/лингвистических способностей, мотивации к обучению иностранному языку; очерчен круг параметров тестирования, не связанных с изучением конкретного языка, однако дифференцирующих способности и мотивацию к его изучению; составлен вопросник на основе выявленных параметров. Полученный тест апробирован в группе студентов, уровень способностей и мотивированности которых определен. По итогам результатов тестирования и уже известных эмпирических знаний о студентах скорректированы тестовые задания, верифицированные по уровню и направлению подготовки обучающихся.

Методы. Для описания специального входного теста для студентов-первокурсников, приступающих к изучению нового иностранного языка в негуманитарном вузе, создана тестовая технология выявления когнитивных, психологических, интеллектуальных, мотивационных характеристик языковой личности обучающихся, на основании которой разработаны параметры тестирования, созданы вариативные разноуровневые блоки вводного теста.

Результаты. В логике заявленного эксперимента проведена верификация исходного варианта теста, его апробация в группах студентов-первокурсников по окончании обучения в первом семестре. Оценивание их потенциала в изучении иностранных языков рассматривалось в качестве экспертной оценки для определения надежности и валидности теста. С учетом верификации проведена последующая коррекция как самих тестовых заданий, так и ответов на них.

Выводы. При прогнозировании успешности иноязычной учебной деятельности студентов, зачисленных в группы по изучению иностранного языка с нулевого уровня, считаем целесообразным и продуктивным проведение подобного рода тестирования перед началом первого семестра. По итогам предложенной диагностики весьма актуальной представляется разработка персонализированных адаптивных программ иноязычной подготовки таких студентов в неязыковом вузе.

Ключевые слова: тестирование, входной тест, изучение иностранного языка с нуля, языковые способности

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1. INTRODUCTION

Traditional methods for foreign language teaching at non-humanities universities do not always produce the necessary results to support the future professional activity of students. One common problem faced by teachers is the need to establish a basic level of knowledge, skills and abilities of a number of students in order to bring them to the level required for their subsequent advancement through the curriculum, which greatly complicates the educational process of teaching a foreign language.

Currently, numerous studies aimed at developing innovative technologies in the field of foreign language training of students are being carried out. Adaptive, personalized technologies for teaching foreign languages are being introduced [1–3]. Since each applicant has a different initial knowledge base and background, opportunities for mastering educational material vary considerably. Therefore, there is a need to focus on a student's personal characteristics, helping him or her to build an individual trajectory for successful language acquisition [4, 5]. At the same time, this approach need not violate the boundaries of an integral system of educational standards, curricula, and learning objectives.

In order to determine the initial level of foreign language proficiency of those entering a university, some kind of entrance lingua-didactic testing is typically carried out to form language groups having the corresponding level of language preparation. Along with the various test forms (input, current, intermediate, final) to determine the level of students' knowledge, there is a considerable amount of published scientific literature on the issue [6–9].

For this reason, entrance testing becomes an important initial stage in the formation of a student's portfolio, forming the basis on which their further educational activities can be planned. In the pedagogical literature, however, the question of how entrance tests are used to determine the initial level of language training obtained in a secondary school is still under discussion [10–14].

The practice of teaching a foreign language at a technical university demonstrates that students entering a university with existing knowledge of one foreign language sometimes have to learn another foreign language from scratch. In this context, existing entry tests are not applicable. In order to implement an adaptive approach, it is necessary to divide the groups of students into subgroups in accordance with their potential for learning a foreign language. Thus, there is a need to develop a special test within the framework of adaptive technologies that cover the most important personal characteristics: psychological, cognitive and linguistic along with the level of motivation in language learning.

To date, a relatively small number of researchers are developing the issue from the above-described perspective. The following studies are closest to the matter under consideration [15–17]. Some researchers recommend that the testing of language abilities should be carried out in the process of foreign language activity, that is, if a student does not know the basics of foreign language acquisition, then the identification of his or her innate language abilities becomes problematic [18–20]. However, other researchers consider that linguistic understanding is formed prior to targeted language acquisition [21, 22], on which the existing psychological tests for identifying language abilities are based¹ [23–30]. In this work, we use such described tests as a section of the questionnaire.

The purpose of the present study was to create a special entrance test for first-year students who are beginning to learn a new foreign language. To achieve the goal of the study, the following theoretical research methods were applied and the subsequent problems were solved:

- 1) analyze the scientific literature on the issues related to testing linguistic abilities and motivation to learn a foreign language;
- 2) outline a range of testing parameters, which are not related to the study of a particular language, but instead reveal the ability and motivation to study it;
- 3) design a questionnaire based on the identified parameters;
- 4) try out the obtained test on a group of students, whose level of abilities and motivation is already known, in order to compare test results with already known empirical (expert) knowledge about the students;
- 5) adjust test items if necessary.

In investigating the psychological, personal, psychophysiological characteristics of applicants, the present work considered the entrance testing of students prior to enrolling them in a group for studying a foreign language from scratch. The theoretical significance of this work is due to the lack of a single test relating to the lingua-didactic type for applicants' preliminary testing. The practical relevance of the work is determined by the need to obtain certain preliminary personalized data about students who begin to learn a foreign language from scratch.

2. MATERIAL AND METHODS

The study was carried out within the scope of an adaptive approach, requiring the development of technologies for individualization of learning. The material for this comprised a special entrance test designed for diagnosing

¹ As well as: Tarasova E. *Test na lingvisticheskuyu intuitsiyu (Linguistic intuition test)*. <https://subscribe.ru/group/obo-vsyomponemnogu/15246393/>. Accessed January 31, 2022 (in Russ.).

the particular cognitive, psychological, linguistic and motivational characteristics of students setting out to learn a new foreign language at a non-linguistic university. As part of the experimental methodology, the test was tried out on the first-year students whose language abilities had already been assessed by teachers. The methodology included a comparison of the results of the entrance test with the expert assessments of students' knowledge and capabilities to serve as a basis for adjusting test tasks and interpreting answers to them.

3. THEORETICAL BACKGROUND

3.1. Individual psychological characteristics and their diagnosis

In addition to tests examining the level of students' knowledge in terms of their foreign language competence, tests are used to determine the general level of language proficiency and speech activity, as well as to identify linguistic abilities [6, 8, 10, 21, 31, 32]. Within the framework of adaptive technologies, the development of tests aimed at identifying applicants' individual psychological characteristics, [33, 34] namely memory, attention, motivation, thought processes, and emotional states, are of great importance.

Many tests have been developed and designed to investigate human cognitive abilities related to language learning. However, a number of researchers point to various inadequacies in the available tests, which cannot be used to evaluate intellectual abilities in general, but only some intellectual skills and thinking features (in the epistemological sense [35]) formed at the time of testing.

Tests for "the success of the verbal functioning of an individual in the society" include the following questions:

- firstly, on general intelligence ("the ability to logical reasoning, planning, problem solving, abstract thinking, the ability to understand complex ideas, the speed of learning and the ability to benefit from the experience gained," linguistic, spatial abilities);
- secondly, on verbal abilities (definition of concepts, mental analysis and synthesis in verbal form, the establishment of verbal similarities and differences) [36, p. 127].

Also of interest in this connection are the Wexler scales to detect mental abilities, including verbal and nonverbal, which are used to define various features of memory, thinking, attention, and visual perception [33, 37].

The tests developed by John B. Carroll and Stanley Sapon aimed at identifying special cognitive abilities—mechanical associative memory (rote associational memory), the ability to recognize and derive rules (inductive ability), phonetic coding ability, and the perception of grammatical relations (grammatical sensitivity)—are also relevant [23, 24].

Tests for studying the motivational sphere of personality [38–40] have also been created. However, such tests, which are mainly designed for schoolchildren and job seekers, are underapplied to university students [41].

3.2. Language abilities and their diagnostics

The issue of determining linguistic abilities and giftedness has been repeatedly raised in the psycholinguistic literature [18, 23, 36, 42–46]. However, while various indicators of the general giftedness of learners [20, 33, 47, etc.] and conditions for assessing linguistic abilities [19, 31, 48, 49] have been described in detail, a universal common approach is yet to be developed.

Linguistic ability/giftedness is also diagnosed by the following verbal-semantic methods: free associative experiment [50], associative-translation method² [20], the word semantics method [15, 16, 51], and the remote associates test³ [52, 53].

Linguistic tasks for new interpreters [17] combine linguistic, mathematical and logical methods of language research in one task that allows a subject's understanding of the language structure and the laws of its functioning to be evaluated. This collection of tests determines linguistic abilities along with the ability to apply logical reasoning and linguistic thinking.

Paul Pimsleur's *language aptitude battery* [28] is aimed at identifying potentially underperforming students before they start learning foreign languages. Pimsleur highlights three factors that determine the success of mastering foreign languages: (1) the level of speech development, determined by using the "Vocabulary" test (individual lexicon in one's native language); (2) motivation and interest in learning a foreign language; (3) sound difference and quasi-signal-based communication.

L.A. Khokhlova's complex psychological and diagnostic approach to the study of students' language abilities is based on the hypothesis of M.M. Gohlerner and G.V. Eiger [21], showing that speech transformations, interverbal connections, and generalizations are formed faster and easier in the presence of linguistic talent [21, 54].

There is also a psychophysiological instrumental method for determining linguistic talent (using functional magnetic resonance imaging along with neurolinguistic programming), which has its own specifics [31, 54].

² As well as: Romanovskaya N.V. *Yazykovaya sposobnost' kak determinanta ponimaniya inoyazychnogo teksta* (Language ability as a determinant of understanding a foreign language text). Abstract of thesis. Tver; 2004 (in Russ.).

³ Remote Associates Test (RAT) test as adapted by T.V. Galkina, L.G. Alekseeva, L.G. Khusnutdinova; for adults, by A.N. Voronin.

Thus, the tests available today are typically used to diagnose a person's characteristics from only one point of view, which means that they are homogeneous. As such, there is still no unified multi-component test for preliminary testing of applicants enrolling in a group for beginner learners of a foreign language. In their work when developing the test, the present authors have analyzed and taken into account achievements of domestic and foreign researchers who have studied various aspects of the linguistic personality.

4. STUDY AND RESULTS

The development stages of the test considered in this paper correlate with the standard stages of any professional test compilation [55–57]:

1. **Determination of the testing goals**, i.e., diagnosing the linguistic potential of an applicant who enrolled in a group for learning a foreign language from scratch.
2. **Selection of the educational material content**. For this purpose, an analysis of the cognitive, psychological, motivational, some intellectual and individual characteristics of a student's personality, needed for the successful mastering a foreign language was carried out.
3. **Compilation and assignment of test items**. **Test examination**—the compiled test is heterogeneous; the developed tasks are assembled into several blocks referring to various aspects of the applicant's linguistic and intellectual abilities; an independent expertise is carried out by the teachers of the Foreign Languages Department of the RTU MIREA to evaluate the qualitative characteristics of the test items in accordance with certain parameters.
4. **Approbation of test tasks**, i.e., after the design of the developed test tasks, a single multi-component test was offered to first-year students.
5. **Determination and calculation of quality indicators for the test items**, which implies testological investigation of both individual test items and the test as a whole, statistical processing of approbation results, establishing quantitative values of the characteristics of the tasks proposed and the definition of a normal distribution.
6. **Task rejection and preparation of the test**—tasks that caused severe difficulties for the majority of subjects or, on the contrary, were successfully and quickly passed by all the test takers, were replaced by other ones or excluded from the test.
7. **Second approbation and preparation of the final version of the test**.

The content of the developed test corresponds to the scheme of any closed-type test and includes:

- 1) instruction for test takers, which includes information about the number of questions and time to complete the test, score per each answer, etc.;
- 2) test questions;
- 3) correct answers (at the teacher's disposal);
- 4) evaluation parameters.

When developing the test, the authors sought to comply with the necessary requirements for the test, such as:

- 1) validity;
- 2) sufficient reliability;
- 3) compactness.

When writing the test, attention was paid to the possibility of conducting it under certain conditions. An important component in the content of the test was a system for objective evaluation in scoring, as well as considering the test's rationality and complexity.

The developed test is aimed at identifying the psychological and cognitive characteristics of a student, on which basis a model is then created in the individual trajectory of each student learning the foreign language from scratch [58].

The questionnaire consists of several blocks affecting various aspects of the linguistic personality and general learning competence of students. The included questions are aimed at defining:

- 1) level of development of language abilities;
- 2) responsiveness to a given practical task;
- 3) ability to analyze, synthesize, generalize and compare, establish logical relationships, select elements from a whole;
- 4) individual memory features required for language learning;
- 5) level of student's motivation in language learning.

The amount of time to complete the test has also to be taken into account.

The first block contains tasks aimed at identifying the ability to work with linguistic signs and concepts, for example, decipher anagrams, find synonyms and antonyms for the given words, and fill in gaps in words, in texts, and proverbs. Despite the fact that the test questions relate to the Russian language, the correctness of the answers to them demonstrates general linguistic abilities.

Here are some examples.

Fill in the missing words in the text:

For centuries, people have been sure that a magnet must be a metal. Even a quarter ... ago, hardly ... could assume that such ... can ... others ... They ... did not think about it—they do not exist in nature. Moreover, the idea to synthesize magnets ... be ... fantastic.

Ferromagnetic substances can ... into magnetically soft and magnetically hard ones, depending on how they ... or retain their magnetic properties.

A soft magnetic substance is the substance made of ferromagnetic material, which ... in that it loses its magnetic properties after magnetization and ... from the external magnetic field. Magnetically soft material requires pure iron and low carbon steel.

A hard magnetic substance is the substance ... of ferromagnetic material, which differs in that after ... it retains its magnetic properties for a long time after removal from the external magnetic field of the magnet. Hard magnetic materials are, for example, permanent magnets (Sm—samarium, Nd—neodymium).

Solve the anagrams and eliminate the extra word:

ALETB ECGINLI RHCIA DRAWOBRE

The second block contains tasks that test the lexical potential of a particular student, including his ability to put the right word in a certain context. These tasks include identifying an extra concept, selecting suitable words, hyponyms, and hypernyms, defining concepts, and describing polysemantic words. For example, a task like this:

Replace the dots with a word that would mean the same as the words outside the brackets:

Kind of sport (...) a container

Find the word that is different in meaning from the rest:

Laurel
Triumph
Vertex
Fiasco

Choose synonyms or antonyms for the words:

amorphous—reduced / defined / limited / hostile

Which series has a negative value?

- 1) hell, angry, illegal, ex-president
- 2) importance, antimony, invisible, reduction
- 3) encourage, uncertain, inversion, indifferent
- 4) countertops, irrigation, unpaid, demilitarize

Generalize and restrict concepts, i.e., find a more general concept (hypernym) and a more specific one (hyponym) for each given concept:

Adverb (part of speech; syntax; adverb measures; speech; verb)

In the following tasks, analyze the concepts, i.e., identify essential and random features:

Human anatomy (academic subject, science, boring lesson, complex science, studies a person, part of natural science)

The word 'garden' is given and the words in parentheses (plants, gardener, dog, fence, land). From the words in brackets, you need to choose words that denote the main features (without which a given concept cannot exist).

Find pairs of concepts that are in causal relationships with each other:

Ice formation, north, frost, weather, snow

For each concept, select such concepts that are in a functional relationship with it:

Drawing — ...; lake — ...; bee — ...; number — ...; task — ...

The third block presents in our opinion the most characteristic tasks to a certain extent reflecting some intellectual abilities of a subject. This included tasks for establishing logical connections, determining common semantic and lexical and grammatical characteristics between words, identifying errors, establishing language patterns, etc.

After analyzing the chain of letters, you need to find the missing letter:

W, T, P, M, I, ...

After analyzing the chain of letters, you need to insert the missing letter:

A	D	G
D	H	L
H	M	?

Insert the missing word:

BOOKS (KIDS) DIG

SIEGE (...) MAY

Which series consists of internationalism words?

- 1) revolution, sport, science, nation
- 2) electric, ferment, molecule, experiment
- 3) exhibition, atom, today, actor
- 4) insert, automobile, computer, word

Which of the following statements represents a point of view?

Life has a beginning and an end.

Cucumber is 90% water.

Artificial fibres worsen our lives.

The oceans cover two-thirds of the Earth's surface.

Which word does not refer to the other two?

think, see, hear

When developing questions regarding the definition of memory features, we relied on the methods available in psychological science.

In particular, simple introspective questions were asked, such as *Do you have a good memory? Do you memorize poems easily? After reading a one-page story, can you retell it in detail?*

We used the method of preliminary diagnosing short-term memory by the known method of ten words, as well as memorizing sentences related and unrelated to each other for 15–30 s.

Long-term memory was diagnosed using the same 10 words and sentences, but written by the subjects after 40–60 min of testing on other tasks and without repeating them.

The fifth block of questions concerned the applicants' motivation in foreign language learning. This block included introspective questions such as: *what is more important for you grades or knowledge?*, *Specific questions about the personal goal of language learning—I will need French: 1) for traveling and / or communicating with French-speaking friends;*

2) *in the future profession*; 3) *to be an educated person*; 4) *speak another language is just great*; 5) *I do not think I will need it, I have no choice, I have to study a foreign language at the university, otherwise I won't get a diploma*; 6) *Maybe I do not need French, but I just got tired of learning a foreign language that I had at school*; 7) *... I may not need it, but I really like French*; 8) *I need a foreign language because I prefer to watch foreign films and read books in the original*).

General questions were asked in a veiled form to affect the latent character traits, but relate to the motivational aspects of the subject's behaviour.

(In my behaviour at my future job, I need to follow the principles:

1) *I need to move up the career ladder*; 2) *Work is a forced necessity in order to live*; 3) *The most important thing is gaining credibility and recognition*; 4) *It is necessary to strive to comfortable environment*; 5) *It is important to find something exciting at work*; 6) *One should constantly improve in his work*).

The amount of time spent by a subject to complete the test is not a separate block, but is included in the study and evaluated using a scoring system. Here, it is hypothesized that the faster and more successfully a test is passed by the subject, the higher that subject's linguistic potential; the more time spent on passing the test when it was not very successful, the less the linguistic potential. There are cases of successful test completion by subjects who spent more time than was allocated. The explanations for such results can include natural slowness, search for information from extraneous sources due to an inability to do the test from memory, increased distraction and attention deficit.

While the listed factors do not contribute to the successful acquisition of a foreign language within the narrow framework of the curriculum at a technological university, they affect the number of points received.

There are examples of quick but unsuccessful completions of a test, which can be explained by a student's frivolous attitude to the matter at hand, which also does not contribute to the success of learning of a foreign language.

All five blocks of the test are combined into a single test presented to students. The amount of time spent on its execution is measured. Points are summed up. For a single entrance test, one can get up to 100 points: those who score 70–100 points go to the advanced subgroup of the experimental group, those who score 55–69 points go to the middle subgroup, and those who score less than 55 points join the third subgroup for weak students.

5. DISCUSSION

The predictive test under consideration was constructed by teachers of English and French for the preliminary diagnosis of the psychological and

cognitive potential of students who had just entered RTU MIREA (Institute of Information Technologies, Institute of Artificial Intelligence, Institute for Advanced Technologies and Industrial Programming, Institute of Management Technologies, Institute of Radio Electronics and Informatics). This contingent of students was enrolled to study a foreign language from the starting level. At the time of admission to the university and the beginning of classes, teachers know neither the students' cognitive and psychological characteristics nor their linguistic abilities. For the successful language mastering, it is advisable to conduct preliminary diagnostic of a linguistic personality.

Prior to testing applicants, the final version of the developed test was tested on first-year students at the end of the first semester, when the level of their language potential becomes obvious.

The test was offered to 71 first-year students of RTU MIREA. 22 students received high scores, 32—average scores, while 17 were awarded low scores.

In order to process the results and determine the validity of the test for its further use among applicants, the differentiating power of test items was analyzed based on the correlation coefficient of each item with the final score obtained for the entire test. This coefficient, if it is more than 0.5, distinguishes between *advanced* and *lagging* students.

Having compared and analyzed the results of testing and the abilities of students demonstrated in foreign language classes, we can conclude that, in general, the diagnostic results were to be expected. However, there were some discrepancies—the number of students who studied well turned out to be slightly larger than the number of students who received higher test scores. This can be explained by the fact that applicants who studied the foreign language at the institute for two or three years had enrolled to study it from scratch. This contingent of students mastered the program faster and more successfully. This can be explained by the fact that students of non-linguistic universities are subject to different language proficiency requirements than those for students of language universities.

We would like to pay special attention to the block of the test concerning motivation. The test results showed that the motivation to learn a foreign language is often determined by pragmatic social factors: getting a higher education, obtaining good employment, etc. In such cases, a student's progress in learning activities at various stages of language learning will obviously be less successful.

Diagnostics of some intellectual abilities of RTU MIREA first-year students under testing shows that, in general, students have a normal and sometimes a reduced level of development of linguistic and general intelligence.

6. CONCLUSIONS

The created diagnostic technology for studying the general intellectual, linguistic, and motivational components of a first-year student's linguistic personality is aimed at predicting the success of foreign language learning activities, developing and implementing personalized adaptive training programs and using them in the educational process based on diagnostic results.

Statistical calculations were carried out with respect to the normal distribution, standard deviation, variance, degree of difficulty and correctness of tasks and answers to them, as well as correlations and homogeneity within individual test blocks, considering the reliability and validity of each block. The initial version of the test was adjusted in accordance with the results of calculations. Thus, the results of the conducted research support the belief that the final version of the test, aimed at preliminary diagnosis of linguistic abilities and motivation of applicants, was sufficiently accurate to reflect the characteristics of the linguistic personality in order to adequately distribute the students by rank. This means that the obtained test results can be used to personify foreign language teaching from starter level at a non-linguistic university.

Alongside the actual practice of conducting classes in such groups, the test results demonstrate that the language learning process is greatly facilitated by the presence of at least minimal existing knowledge, skills and abilities on the part of a student studying a foreign language from scratch. On this basis, we believe that when forming student groups, it is advisable to determine both the subject's score for predictive testing and the presence of at least minimal knowledge, abilities and skills in a chosen foreign language. If an applicant has certain knowledge, abilities and skills, but received an average score on the main test, he or she should, nevertheless, be taken in the strong student group. If a student receives a low score for testing, it is necessary to conduct diagnostics in the

corresponding foreign language in order to determine the level of his knowledge, abilities, and skills. This fact is important, since it is known from teaching experience that the level of foreign language proficiency remains quite low even after ten years of learning a foreign language, never mind a period of two-three years of language learning in a secondary school.

The results of the pre-diagnostic testing in the framework of the adaptive learning technologies at the very initial stage of teaching a foreign language to non-linguistic students support certain conclusions on the organization of further language learning. Although the results cannot be claimed to comprise an absolute criterion of effectiveness in mastering the foreign language, carrying out such assessments of the psychological and cognitive characteristics of future students in terms of their personal potential and motivation to learn a language will certainly contribute to the improved quality of foreign language teaching at a technological university starting from the first semester.

Authors' contributions

N.I. Chernova – justification for the study concept, research findings synthesis.

E.A. Ivanova – analysis and synthesis of the literature, drafting the manuscript.

N.B. Bogush – study of domestic and foreign publications on the issue, developing the experimental work algorithm.

N.V. Katakova – formulation of the conclusions, interpretation of the study results.

Вклад авторов

Н.И. Чернова – обоснование концепции исследования, обобщение результатов исследования.

Е.А. Иванова – анализ и обобщение данных литературы, оформление рукописи.

Н.Б. Богущ – исследование отечественных и зарубежных публикаций по проблеме, построение алгоритма опытно-экспериментальной работы.

Н.В. Катахова – формулировка выводов, интерпретация результатов исследования.

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About the authors

Nadezhda I. Chernova, Dr. Sci. (Pedagog.), Professor, Head of Foreign Languages Department, Institute of Radio Electronics and Informatics, MIREA – Russian Technological University (78, Vernadskogo pr., Moscow, 119454 Russia). E-mail: chernova@mirea.ru. Scopus Author ID 57194042371, RSCI SPIN-code 7391-4040, <https://orcid.org/0000-0002-5685-9733>

Ekaterina A. Ivanova, Cand. Sci. (Philolog.), Assistant Professor, Foreign Languages Department, Institute of Radio Electronics and Informatics, MIREA – Russian Technological University (78, Vernadskogo pr., Moscow, 119454 Russia). E-mail: ivanova@mirea.ru. Scopus ID 57216646627, RSCI SPIN-code 8980-5591, <https://orcid.org/0000-0001-6891-4966>

Nadezhda B. Bogush, Cand. Sci. (Philolog.), Assistant Professor, Foreign Languages Department, Institute of Radio Electronics and Informatics, MIREA – Russian Technological University (78, Vernadskogo pr., Moscow, 119454 Russia). E-mail: bogouchn@mirea.ru. RSCI SPIN-code 9258-6672, <https://orcid.org/0000-0003-0332-1136>

Nataliya V. Katakhova, Cand. Sci. (Pedagog.), Associate Professor, Foreign Languages Department, Institute of Radio Electronics and Informatics, MIREA – Russian Technological University (78, Vernadskogo pr., Moscow, 119454 Russia). E-mail: katakhova@mirea.ru. Scopus Author ID 57204175929, RSCI SPIN-code 2552-5380, <https://orcid.org/0000-0002-9416-5011>

Об авторах

Чернова Надежда Ивановна, д.пед.н., профессор, заведующий кафедрой иностранных языков Института радиоэлектроники и информатики ФГБОУ ВО «МИРЭА – Российский технологический университет» (119454, Россия, Москва, пр-т Вернадского, д. 78). E-mail: chernova@mirea.ru. Scopus Author ID 57194042371, SPIN-код РИНЦ 7391-4040, <https://orcid.org/0000-0002-5685-9733>

Иванова Екатерина Александровна, к.филол.н, доцент, кафедра иностранных языков Института радиоэлектроники и информатики ФГБОУ ВО «МИРЭА – Российский технологический университет» (119454, Россия, Москва, пр-т Вернадского, д. 78). E-mail: ivanova@mirea.ru. Scopus ID 57216646627, SPIN-код РИНЦ 8980-5591, <https://orcid.org/0000-0001-6891-4966>

Богущ Надежда Борисовна, к.филол.н, доцент, кафедра иностранных языков Института радиоэлектроники и информатики ФГБОУ ВО «МИРЭА – Российский технологический университет» (119454, Россия, Москва, пр-т Вернадского, д. 78). E-mail: bogouchn@mirea.ru. SPIN-код РИНЦ 9258-6672, <https://orcid.org/0000-0003-0332-1136>

Катахова Наталия Владимировна, к.пед.н., доцент, кафедра иностранных языков Института радиоэлектроники и информатики ФГБОУ ВО «МИРЭА – Российский технологический университет» (119454, Россия, Москва, пр-т Вернадского, д. 78). E-mail: katakhova@mirea.ru. Scopus Author ID 57204175929, SPIN-код РИНЦ 2552-5380, <https://orcid.org/0000-0002-9416-5011>

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