

Ergonomic aspects of computer-oriented pedagogical technologies implementation in teaching foreign languages to students of higher education institutions

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Abstract. The paper reveals the content of the research aimed at studying the possibilities of computer-oriented technologies in the intensification of teaching foreign languages to students of non-linguistic specialties. The content of pedagogical foreign language learning technologies has been characterized; their classification has been carried out. The role, place and advantages of instrumental technologies in teaching methods update of a foreign language in the digital society have been shown. The main types of instrumental technologies that allow to increase the efficiency of teaching foreign languages have been identified, among them the following ones have been mentioned: technologies of technical teaching aids application, computer learning technologies, telecommunication technologies, and hybrid model of instrumental technologies. The leading part of ergonomic principles and methods for designing a learning environment that provides the most optimal ratio of modern digital and traditional intensive technologies for learning foreign languages have been emphasized. The criteria have been formulated, the methodology for diagnosing the level of ergonomics of the educational environment using the method of expert assessments has been disclosed. The positive dynamics in the level of ergonomics of the educational environment, which is designed on the basis of the use of instrumental technologies for teaching foreign languages, has been shown. The conclusions regarding the effectiveness of methodological approaches to designing an ergonomic educational environment using instrumental technologies for teaching a foreign language have been formulated.

Keywords: pedagogical foreign language learning technologies, instrumental technologies, technologies of technical teaching aids application, computer learning technologies, ergonomic approach, learning environment design

1. Introduction

In connection with Ukraine entry into the European educational space, European integration, internationalization of business relations and professional activity, the problem of personal development and professional success is singled out, which today is undoubtedly associated with fluency in foreign languages, learning intercultural communication through the latest technologies.

In the context of modern educational concepts, in terms of democratization of society and

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socio-economic reforms in Ukraine, higher education is based on the principles of fundamentalization, systematization and humanization of knowledge, competency and cultural approaches and involves social determination of target guidelines. The dominant place among the educational goals belongs to the creation of conditions for the formation of personal qualities of students, in particular communicative, as well as traits mediated by the level of their foreign language communicative competence – ability to academic mobility, autonomous learning and lifelong learning.

Meanwhile, taking into account the specifics of teaching foreign languages to students of non-language specialties and the uniqueness of the current stage of development of digital and globalized society, a number of unresolved *contradictions* still remain. They are, in particular, between the urgent needs of society for professionals capable of intercultural foreign language professional communication, the growing amount of professionally oriented information in foreign languages and the possibilities of educational systems, limited time and extensive type of foreign language training of students in institutions of higher education.

The *purpose* of the paper is to research the possibilities of computer-based technologies in teaching foreign languages to students and ergonomic foundations in the design of the appropriate educational environment with the use of these technologies. The authors are going to reveal the classification of pedagogical technologies for teaching foreign languages, among them they will focus on characteristics and types of instrumental technologies applying for goals of intensification of teaching students. Yet another task of the paper is producing the sense of ergonomic analysis, as well as the methods of its use to design an environment for teaching foreign languages. In addition, the criteria and diagnostic tools for evaluation of designing the educational environment for learning foreign languages will be illustrated and clarified; the results of their approbation in real educational process will be shown and analyzed.

2. Materials and methods

The experience of studying foreign languages for special purposes in non-language institutions of higher education contains a lot of thorough work on the use of modern methods, forms, techniques of activating the educational process, increasing its efficiency. Thus, the theory and methodology of communication in a foreign language are disclosed in works of Lyakhovitsky and Koshman [16], Nikolaeva and Synekop [20], Tarnopolsky, Volkova and Kozhushko [30], Zimnyaya [34]; problems of students' foreign language communicative competence and foreign language culture formation – Buzhykov and Buzhykova [2], Holiver, Kurbatova and Bondar [8], Tokarieva et al. [33].

The results of leading scientists and teachers-practitioners work analysis show that the reduction of the volume of foreign language learning in non-language institutions of higher education to a critical value has led to the loss of its effectiveness. This primarily influences the level of competitiveness of graduates, reduces academic and professional mobility, the inability of most bachelors to continue their studies at the next level of higher education. That is why in the scientific literature there are more and more works on the conceptualization of empirical developments in the application of the latest pedagogical technologies that are able to ensure the process of intensive learning of foreign languages by students of non-language specialties

(Bespalko [1], Klarin [10], Strelnikov [29]), in particular, using digital technologies (Buzhykov [3], Bykov and Shyshkina [4], Gurevich, Gurjii and Kademiya [7], Kukhareenko [11], Tkachuk et al. [32]).

The works of researchers on the theoretical substantiation of methodological bases, genesis and experience of pedagogical technologies application (Driscoll [5], Lynch [17], Molnar [18], Negoescu and Bostina-Bratu [19], Skinner [26], Stanford [28], Thorndike [31]) also make an important basis for scientific research; as well as their adaptation to domestic conditions and development on this basis of new pedagogical technologies for teaching foreign languages (Lozynska et al. [15], Rozhkova [23], Serdyukov [25]).

Researchers also constantly emphasize the need for qualitative changes in the methodology of teaching foreign languages. In particular, it means the transition from extensive to intensive studying, in so far as in the process of extensive studying the capabilities of the brain are used by only 15–20%. At the same time, methods based on intensive teaching require excessive expenditure of mental energy. Thus, the discrepancy between the modern requirements of the digital society to improve the efficiency of learning and the shortcomings of modern methods of knowledge mastering raise the problem of developing such educational systems, which would be commensurate with the intensive work of lecturers, but without their excessive workload. These and other related issues are taken care of by pedagogical ergonomics, taking into account the achievements of which provides an opportunity to significantly increase the effectiveness of pedagogical technologies for teaching foreign languages (Gervas [6], Karapuzova, Pochynok and Pomohaibo [9], Lavrentieva [14], Okulova [21], Skydan [27]).

Therefore, the above overview of modern foreign language learning technologies allows us to focus on the study of such issues as: classification of existing pedagogical foreign language learning technologies, the role, place and importance of instrumental technologies updated in the digital society, as well as ergonomic principles and methods of designing a learning environment that provides the most optimal ratio of modern digital and traditional intensive technologies for learning foreign languages.

3. Theoretical background

Content development research of “pedagogical technologies” concept singled out its long evolution. The genesis of pedagogical technologies can be found in technical teaching aids. For the first time the principle of manufacturability was formulated by Thorndike [31]. However, the mechanism of technologicalization of the educational process – its construction with rigidly planned, fixed results, was outlined by Skinner [26] in the concept of programmed learning. Thus, the level of implementation of pedagogical technologies in the educational process is subject to the vector of pedagogical systems development, is determined by the type of social thinking and is associated with scientific and technological progress of society and the introduction of new techniques.

It is established that the modern theory and practice of introduction of the technological approach in training offers numerous interpretations. We are close to the opinion of those scientists, who link the existence of hitherto contradictory interpretations of pedagogical technologies with the uncritical extrapolation of foreign scientific works to the domestic educational

space [12].

The conducted semantic analysis allowed to find out that *pedagogical technology* is a system category, which functions autonomously at three semantic levels (scientific, procedural-descriptive and procedural-activity), at the same time is in systemic interrelations and takes its place in the hierarchy of educational, upbringing and didactic technologies. Pedagogical technology is not identical to the type, method, teaching methods, didactic model and the methodology itself [12].

We consider *pedagogical technologies of teaching* as types of concepts from generic “pedagogical technologies” and consider them as being based on modern positions of professional development of the person and directed on achievement of the educational purposes. In the process of learning foreign languages, such technologies are a way of step-by-step system organization of communicative interaction between lecturer and student in terms of prompt feedback between them through the use of specific methods, forms and means of learning. The leading class of pedagogical technologies for teaching foreign languages is communicatively oriented technologies.

A special place among the variety of pedagogical technologies of foreign language teaching belongs to instrumental technologies. Next, we proceed directly to the analysis of their content and role in the intensification of the educational process.

4. Ergonomic bases of using instrumental technologies for designing educational environment for learning foreign languages

4.1. Characteristics of instrumental technologies of foreign language teaching

As a retrospective analysis of existing concepts shows, scholars and educators are constantly looking for tools that intensify the process of learning foreign languages.

Thus, *instrumental technologies of foreign language teaching* are considered as a process of development and application of special teaching aids, which is based on the language training method and is aimed at achieving educational goals.

Depending on the didactic purpose of instrumental technologies of foreign language teaching can be used as: sources of foreign language knowledge, means of organizing their learning under the guidance of a teacher or independently, means of visualization, practice, repetition and systematization of foreign language knowledge for all types of speech activity.

Based on the research of Serdyukov [25], we include in instrumental technologies such interdependent components as:

- 1) technologies of technical teaching aids application;
- 2) computer learning technologies;
- 3) telecommunication technologies based on the use of telecommunication tools and networks.

Our vision of the types of instrumental technologies of foreign language teaching is presented in figure 1.

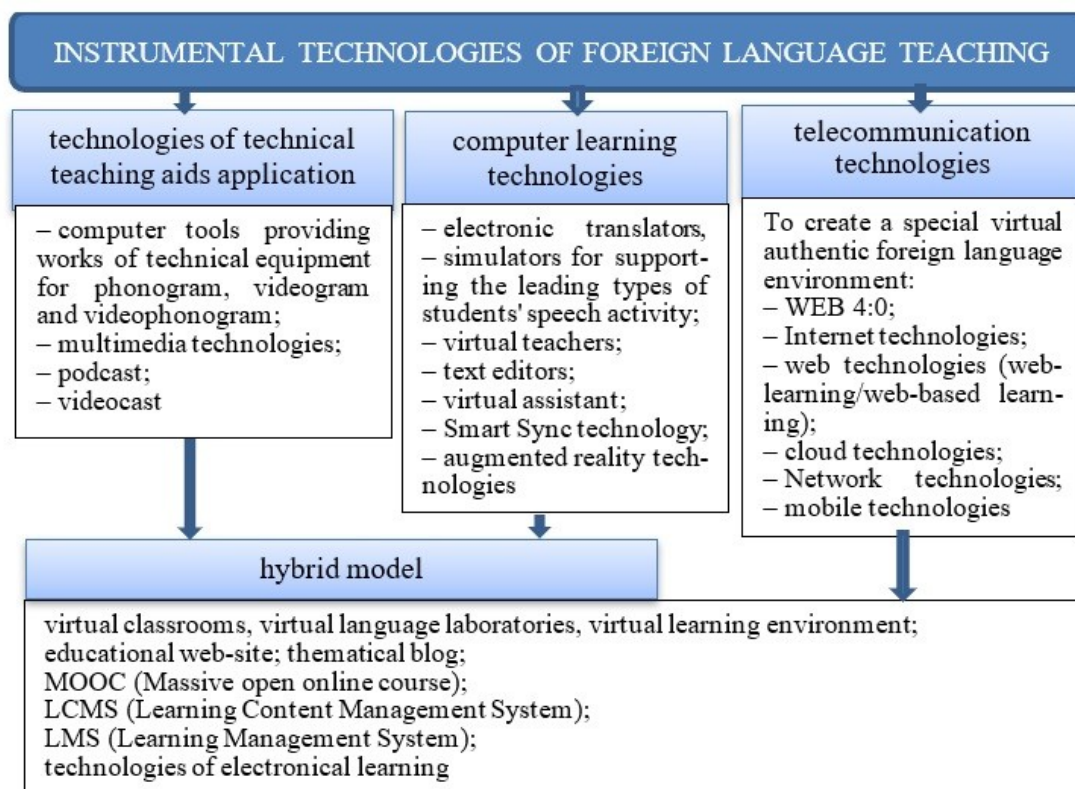


Figure 1: Family of instrumental technologies for teaching foreign languages.

Considering the first component – the technology of modern technical teaching aids application, we should note the following. Despite the fact that modern technical teaching aids are almost entirely digital technical devices, the technologies of their application are based on the approaches developed by Lyakhovitsky and Koshman [16]. The scientist names teaching aids in foreign language learning as a technical means that requires the use of technical equipment for phonogram, videogram and videophonogram [16, p. 60]. This generally accepted of technical teaching aids classification reflects the main means of supporting the leading types of students' speech activity.

Today's technical teaching aids are developed and applied on the basis of computer technology. To use them effectively, integrated computer-based technologies are being developed that significantly intensify foreign language learning. In particular, these are technologies of *podcast* (audio material) and *videocast* (video material), which the author sends by subscription via the Internet, as well as hub technologies.

With the development of equipment and related technologies, it became possible to create fundamentally new *technical teaching aids* – multimedia ones in foreign languages. Their valuable characteristic is the high quality of reproduction of all constituents of its data components, as well as the possibility of their interdependent or complementary use. For example, a combination of video with text and sound; audio fragments with text data on the content of

the audio series; images with music and text [18]. Modern computer-based *technical teaching aids* also helps to master foreign language writing, grammar and spelling skills with automatic control by special programs [22].

Didactically correct use of modern *computer-based technical teaching aids* allows intensification of foreign language learning due to the maximum load of students' language and auditory channels, activation of their mental and speech activities, optimization of knowledge of special professional, intercultural and foreign language phenomena [3].

A special class of tool technologies are Internet, web (web-learning/web-based learning) and cloud technologies. Their significance lies in the ability to use online services for learning a foreign language and work with authentic materials of cultural and scientific kinds. Pedagogical technologies in teaching, built on foreign language Internet information, contribute to the most effective formation of students of all types of foreign language communicative competence, allow to use language as a means of real communication [32].

It seems impossible to ignore the growing prevalence of computer-based foreign language teaching technologies, which allow to form all aspects of foreign language communicative competence. Among them are the following: electronic translators (including network), simulators for learning vocabulary, training of pronunciation, writing and speaking; virtual teachers, interlocutors and assistants; text editors with built-in checking and proofing tools and much more with the use of virtual and augmented reality. Smart Sync technologies provide students with quick access to up-to-date educational information under the guidance of lecturers.

Today, the computer in teaching foreign languages is also a technical means of interpersonal communication based on multifunctional network multimedia learning systems and automated learning systems – *telecommunications technology* [2], which creates a special virtual authentic foreign language environment.

Varieties of instrumental technologies can be used both separately and in combination, simultaneously or sequentially combining different technical, educational, developmental and upbringing capabilities during the performance of pre-explanation exercises by students during explanation, training, repetition and consolidation of educational material.

Given the characteristics of the above subspecies of instrumental technology, Serdyukov [25] quite rightly identifies areas of their application, in particular: technologies for the application of modern *teaching aids* are appropriate in the educational process with a group form of education under the guidance of a teacher; computer technologies – mostly in the organization of independent work and self-education, but also in the system of group classroom learning; telecommunication technologies – mainly in individual training, extracurricular activities and self-education. Computer technology can also be used autonomously and over a network (such as on-line services or Cloud and Smart Sync technologies, LMS, LCMS, Web 4.0, MOOC).

The widespread use of modern digital technologies contributes to the emergence of *hybrid models* of instrumental technology for teaching foreign languages. Technologies of electronic learning are in their heart.

Let us consider further how the educational environment which allows effective use of pedagogical technologies of foreign languages teaching should be designed.

4.2. Ergonomic approach to intensify foreign language teaching

First of all, we should note that *pedagogical ergonomics* is the direction of modern pedagogy, which aims to comprehensively study and design the pedagogical activities of lecturers and students in the system “educator – student – learning environment” to ensure its effectiveness and optimality. The most essential feature of pedagogical ergonomics is the consideration of phenomena in the relationship of the human factor with the factors of the learning environment [6, p. 22–23]. At the same time, pedagogical ergonomics is able to design appropriate options for specific activities related to the use of new technology; to formulate requirements to technical teaching aids, to a level of readiness of teachers and students concerning use of instrumental pedagogical technologies of training, means of intensification of educational process in general [9].

Therefore, the effectiveness of application of pedagogical technologies of foreign language teaching depends on the appropriate design of the learning environment, where the activities of teaching and studying take place in externally and internally plan. This requires taking into account the production, sanitary, anthropometric, psychophysiological and aesthetic factors of study work, which is organized using pedagogical technologies of foreign language teaching [6] (figure 2).

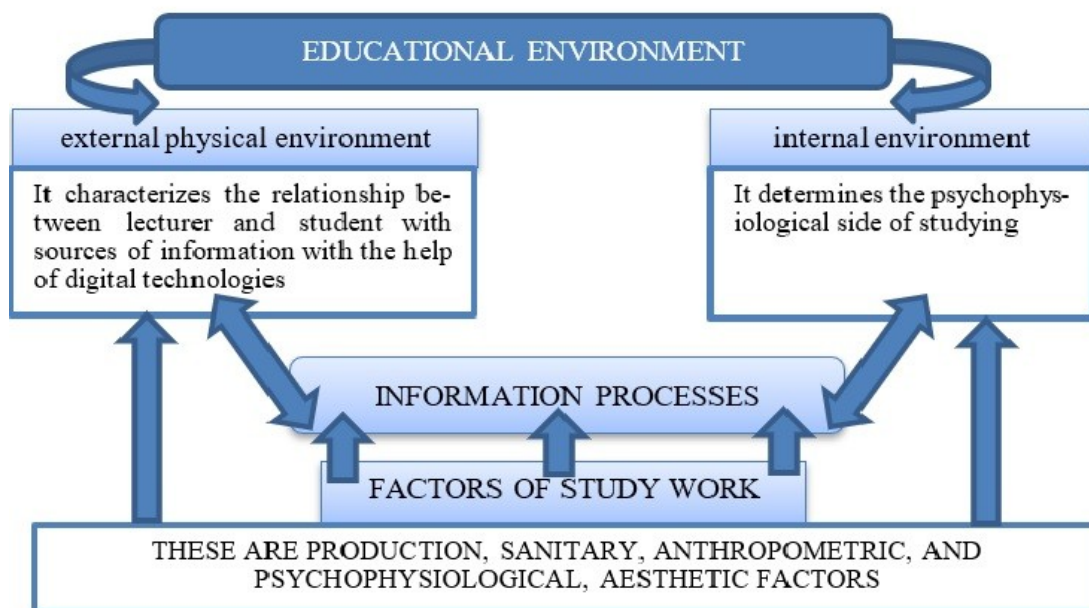


Figure 2: Ergonomic characteristics of educational environment.

The means of pedagogical ergonomics make it possible to determine the appropriate relationship between “traditional” methods and teaching foreign language and computer-oriented instrumental technologies. In particular, pedagogical leaning technologies, introduced from ergonomic positions, take into account the motives, temperament, employment of students,

allow students with special needs to study, activate students' perception of information, increase their emotional tone. Pedagogical teaching technologies, based on pedagogical ergonomics, improve the quality of work through the possibility of proper distribution of time, transfer of routine functions to instrumental technologies, promote the stability of working postures and rational movements, prevent overload, including the language apparatus of foreign language teachers.

The technologies of partnership interaction in the system "lecturer – student – group", based on the principles of ergonomic approach, provide the optimal way to organize educational activities, intensify it, but at the same time prevent fatigue by setting a certain pace, rhythm of educational work and proper feedback. Taking into account the requirements of ergonomics when using instrumental technologies is a guarantee of convenience, reliability and safe use of equipment in the educational process, reducing the intensity of educational work. Didactically correct use of instrumental technologies allows intensification of foreign language learning due to the maximum load of the language and auditory channels of learners, activation of their mental and speech activity, optimization of knowledge of intercultural and foreign language phenomena [14].

Designing the learning environment from the standpoint of pedagogical ergonomics requires the construction of a special language environment for students. Continuing the traditions of pedagogical ergonomics and didactics, we distinguish *two types of learning environment – material and virtual*. The subject-material part of the learning environment of foreign languages consists of: classrooms, language laboratories and students' workplaces, where educational equipment is located, teaching aids, multimedia equipment, mobile interactive devices, etc., as well as virtual laboratories created by modern platforms for remote teaching students using computer and network technologies [27]. It is pedagogical ergonomics that makes it possible to take into account the physical characteristics of sources of foreign language knowledge and the psychological features of their assimilation by means of pedagogical learning technologies.

4.3. Methods of designing an ergonomic environment for teaching foreign languages

We proceed from the fact that the design in terms of pedagogical ergonomics affects the organization of teachers and students in a specially created language laboratory – directly in a classroom and in a virtual laboratory.

Today, the concept of "foreign language classroom" is a special audience (class), equipped with a set of sound, projection and film projection equipment, which allows audio-visual methods to create optimal conditions for students' independent work to master non-native language skills, native language speech culture and professional –performing skills in students' specialty [15].

Under ergonomic requirements, the working space of students, teachers and groups in the classroom in general should be designed for a certain number of study seats (from 10 to 25), and so that each lesson can be organized both individually and in a group, and change forms of work would not cause overload, delays, inconveniences, unnecessary movements of both teachers and students.

We have taken into account that the widespread use of multimedia teaching aids and instrumental technologies based on them makes it possible to properly design the workspace

of foreign language teaching in the language laboratory so as to achieve the required level of functional comfort for lecturers and students.

At the same time, from the point of view of pedagogical ergonomics, it is important to ensure proper processing of information presented by multimedia, in particular – to organize active language practice of students, work on learning foreign languages, solving educational problems. Therefore, in the language laboratory we consider it appropriate to combine the screen on which the image of the learning task is projected, and the board on which such a task can be performed quickly (close test, restored scheme or sequence, support scheme, speech pattern, crossword puzzle, text, etc.) [17]. Such board should be white, have magnetic properties for attaching any illustrative material and be appropriate for work with coloured markers.

A full-fledged language laboratory should provide autonomous and network work of the group, prompt feedback between lecturers and students. This is facilitated by placing the group in a semicircle so that everyone has the opportunity to exchange information while working in a group, during frontal work with the blackboard in both real and online communication. A properly designed learning environment should use Internet communications, including Wi-Fi.

A review of the existing literature revealed the leading software tools for the organization of electronic, combined and blended learning of students in the language laboratory, namely:

- 1) tools of communication: SMS, MMS, smartphone, electronic pager, e-mail, chat, instant messaging, voice and video communication, voice and video conferencing, forums;
- 2) means of presenting educational materials: electronic textbooks, text, hypertext, audio, video (including those located on websites, blogs, wikis, video repositories, podcast servers, slide hosting, electronic libraries, file servers, cloud services);
- 3) means of practicing skills: simulators, virtual classes, electronic translators and dictionaries, multimedia materials, etc.;
- 4) collaboration tools (webinars, wikis, virtual classes, cloud services, web quests, collaborative projects, etc.);
- 5) means of assessment of educational achievements, monitoring and management of the learning process (survey, planning, testing) [5, 13].

The proposed *pedagogical software* (PS) of foreign language teaching was based on a number of requirements, namely: 1) general didactic requirements (individualization, activity, student independence, scientific character, visualization of educational information, etc.); 2) linguistic requirements (correctness and normativeness of the language used); 3) methodical requirements (communicative and professional orientation of PS); 4) electronic-didactic requirements (interactivity, modular construction of the content of the material, multimedia presentation of study information, friendly interface) [2].

In our research, as a basis for the organization of active language practice, we use tools provided by well-known services, including Google, Office 365, Facebook, Edmodo, Studyboard and distance learning platforms such as LMS Moodle. The leading idea in their application was to create a semantic basis for the technology of the *teacher's website* – an interactive didactic tool that allows the organization of interaction between all participants in the educational process. Analysis of advanced pedagogical experience shows that the teacher's website is a holistic information and communication technology that can provide pedagogical guidance in

teaching foreign languages to students [8]. In our practice we use such models of application of the teacher's website technology as: *subject site, educational site, thematic blog, portfolio site*.

Among other existing opportunities for organizing students' work, we chose the LMS Moodle platform, which allows convenient organization of the entire foreign language course [28]. This significantly intensifies the learning process, ergonomically organizes the students' study activities and allows the implementation of many pedagogical technologies for teaching foreign languages – training, design, interactive, game, test, etc., as well as hypermedia, media, multimedia technologies.

According to the results of the analysis of scientific and methodical literature, we came to the conclusion that the structure of the network electronic methodical complex is not regulated. The *electronic complex* developed within the limits of our professional activity includes both the volume obligatory for studying (electronic educational materials, audio and video applications, test materials, podcasts and videocasts, links to them), as well as additional one, constructed on the principle of complex differentiation (glossary of professional terms, materials for independent project activities, additional scientific, technical and linguistic resources, links to reference materials). In addition, the complex combines the advantages of a text editor, e-mail, e-journals and many other attributes of modern information and communication technologies, represented by the LMS platform like Moodle. The object orientation of the platform provided individual adjustment of certain elements of the training course to the needs of lecturers and students.

The educational complex we used for the study of foreign languages is structured in a module, in accordance with the curriculum of the discipline. The structural components of each module are: a text page, a list of links, a book, an explanation, a workbook, a forum, an exercise, a test, a webinar. Each of them consists of such sections as: Reading, Vocabulary, Listening and Video. Materials for study are presented by topics and content training modules. An important part of the complex is a system of test tasks that are processed automatically using the built-in Moodle services. The "Forum" option is used by us for the formation and development of oral and written speech skills, as well as for the organization of foreign language communication [24].

At the same time, we practice the means of a *thematic blog* – a specially created resource, which contains relevant information for students of scientific, technical, cultural, linguistic and professionally significant nature, mostly in a foreign language [22].

The appropriate content of the teacher's website is all kinds of professionally important information provided by means of tool technology. In particular, *TED (Technology Entertainment Design)* presentations are widely used in the work of lecturers of the Department of Foreign Philology, Ukrainian Studies and Social and Law Disciplines of the Mykhailo Tuhan-Baranovsky Donetsk National University of Economics and Trade. *TED* is a private non-profit foundation in the United States that has held annual conferences since 1984 to promote unique ideas. Some of the lectures on science, art, design, politics, culture, business, global issues, technology and the entertainment industry are available on the conference website (<https://www.ted.com/>). Lectures are usually held at a high methodological and linguistic level, their topics concern, in particular, issues of subject specialization of students, as well as their culturological, socio-cultural, linguistic needs. Therefore, videocasts from this site can serve as a semantic basis for the organization of foreign language teaching in non-language institutions of higher education.

Now, there are a lot of websites offering similar services. And this is not to mention the numerous foreign language educational channels on *YouTube*.

In the practice of teaching foreign languages, we usually use two modes of operation. *Synchronous mode* of management of students' study activities involves the use of network technologies and real-time communication, in particular through video conferencing, web conferencing, virtual classrooms, chats etc. [4]. Access to Internet resources, the possibility of authentic communication, acquaintance with the latest advances in science and technology, participation in international discussions significantly increases the level of motivation of students to learn a foreign language. At the same time, there is an intensification of educational activities, when students replenish their vocabulary, improve their receptive and productive skills, form and improve skills of dialogic speech, get acquainted with the culture and traditions of the language they are studying in a convenient time and space format [19].

Asynchronous communication allows us to exchange time-delayed information via the Internet. The possibilities of podcast and videocast technologies, e-mail correspondence, forums, chats, specialized sites, blogs, and electronic libraries can be widely used here. Foreign forums, joint projects with foreign students, quests, postponed conferences, work on foreign language sites, and communities on social networks have significant opportunities in the formation of foreign language communicative competence.

4.4. Effectiveness evaluation of designing the educational environment for learning foreign languages

An important criterion for the effectiveness of pedagogical technologies in teaching foreign languages, along with the level of formation of foreign language communicative competence, is the *ergonomics of the learning environment*, which reflects the degree of influence on lecturer and students of psychophysiological, physiological, anthropometric and hygienic factors. This means assessing the effectiveness of foreign language teaching using pedagogical technologies (accuracy, reliability, productivity of their application) and compliance with human psychophysiology (safety for lecturer and student health, level of tension and fatigue, emotional impact on the process of lecturer and student) [27, p. 11–12].

Ergonomic criterion serves three main factors of influence of pedagogical technologies on the educational environment – technological, labour and organizational ones [27].

The *technological factor* involves the assessment of teaching aids, technical equipment, content and procedural parameters of applied pedagogical technologies. This involves, first of all, taking into account the anthropometric and biomechanical characteristics of the applied technical teaching aids, which should reduce the cost of muscular and mental energy, replace manual processes with automated, reduce static and dynamic load of information channels of students and lecturers. At the same time, in pedagogical ergonomics it is important to assess the degree of manufacturability of the educational process: algorithmicity, conceptuality, expediency, subjectivity, purposefulness, reproducibility, effectiveness, controllability, design, statefulness, etc. A certain level of manufacturability should provide a certain quality of educational material (depth, effectiveness, strength, system) compared to “non-technological” approaches.

The *labour factor* considers the rhythm and intensity of study work, the correctness of individual actions with maximum economy of movement and prevention of awkward position during the work, its compliance with speed, energy, visual and other capabilities of students and lecturers. To the kinetic characteristics of the labour factor adds aesthetic – the conformity

of the design of jobs, objects of labour, components of pedagogical technologies to the aesthetic needs of students and lecturers in the process of foreign languages learning [21].

The organizational factor, first of all, takes into account the organization of the workplace of students and lecturers in the educational environment (in the classroom and virtual language laboratory). Properly organized workplace includes the availability of sufficient workspace; basic and auxiliary language equipment, convenient approach and access to them; the ability to establish physical, visual and auditory connections between the subjects of the educational process; safety priority; compliance with the norms of the working environment (permissible noise level, temperature, light, humidity, etc.), the possibility of remote autonomous studying.

Thus, the *indicators on ergonomics criterion of the educational environment* include: functional comfort of the student; technological, labour and organizational parameters of the educational environment of learning foreign languages with the use of pedagogical technologies and modern technical teaching aids, the quality of learning foreign language knowledge by students, the degree of their sensitivity to new technologies of educational activities.

Ergonomic analysis of the level of functional comfort of students in teaching foreign languages with the use of pedagogical technologies was conducted using the method of expert evaluations (figure 3).

Based on the testing of the card above in the pre-quarantine period, it was found that the reason for most of the failures of students is their failure to master at the appropriate level of pedagogical technologies for studying foreign languages, especially instrumental technologies. Quantitative indicators are shown in table 1.

Table 1

Degree development dynamics of students' study work ergonomics (in %).

Indicators	I study year	II study year	III study year
Elementary	40,0	31,3	25,0
Intermediate	40,0	31,3	31,3
Upper-Intermediate	12,0	20,8	22,9
Advanced	8,0	16,6	20,8

Thus, we singled out the *contradiction* between the existing potential of foreign language teaching pedagogical technologies in the direction of intensification of learning, complex impact on the motivational, cognitive and linguistic spheres of students' personality and the existing average level of effectiveness of their use in the educational process at a non-language higher education institution. A number of *difficulties* have been identified, including: objective difficulties due to economic factors – extremely small amount of time for learning a foreign language in a non-language free economic zone, lack of funding for extracurricular activities and elective courses; insufficient hardware and software of instrumental technologies, limited direct communication with native speakers. There are also difficulties of semantic nature – imperfect development of the educational environment in terms of its ergonomics and functional comfort of students in the language laboratory, as well as procedural nature – insufficient level of mastery of some foreign language lecturers of instrumental educational technologies, especially computer and network; the advantage of technology-transformations in the educational

Parameter	Feature	Evaluation zones	Grade
Technological factor: technical perfection; compliance with anthropometric data; functionality, quality, sufficiency	Language / linguistic laboratory, its equipment	0-10	
	Virtual language laboratory, its completeness	0-10	
	Educational content	0-10	
	Didactic teaching aids	0-10	
	Computer-based technical teaching aids, local area network, Internet	0-10	
	Pedagogical software for teaching foreign languages	0-10	
Labour factor: aesthetics, compliance with psychophysiological and psychological characteristics of a human; requirements of labour protection and hygiene	Classroom design	0-10	
	Virtual lab interface	0-10	
	Rhythm, regularity of the educational process	0-10	
	Ease of use of technical teaching aids, equipment	0-10	
	Labour intensity	0-10	
	Educational and methodical complex of teaching the discipline	0-10	
Organizational factor: time indicators; functionality of educational work, authenticity of content	Student workplace in the classroom	0-10	
	Student workplace in a virtual laboratory	0-10	
	Organization of independent study work	0-10	
	Organization of extracurricular activities (clubs, electives, events)	0-10 and additional 2 points	
	Organization of communication with native speakers	0-10	
	Research work in the specialty by means of a foreign language	0-10 and additional 2 points	

Figure 3: Expert card for assessing technological, labour and organizational parameters of educational environment.

activities of students, uniformity in their use; low share of communicative activity of students, their participation in extracurricular activities for professional interests during their studies in higher education institutions.

At the same time, the experience of application and widespread use of instrumental technologies during quarantine measures, balanced approach and hard work of foreign language teachers in the development of professional skills allowed to achieve significant changes in the levels of ergonomics of the educational environment (table 2).

Table 2

Ergonomic factor dynamic of students' study work (in %).

Levels	December 2019	September 2021
Elementary	40,0	20,0
Intermediate	40,0	30,0
Upper-Intermediate	12,0	30,0
Advanced	8,0	20,0
Pearson's χ^2 -criterion	20,952 > 11,345, $\rho = 0,001$	

This became possible due to the design of the learning environment taking into account the requirements of pedagogical ergonomics, which intensifies the teaching of foreign languages by means of instrumental pedagogical technologies.

5. Conclusions

Having considered the features learning environment design that provides intensive teaching of foreign languages to students of non-linguistic specialties, we came to the following conclusions.

1. The pedagogical technologies of teaching should be considered as types of concepts from generic "pedagogical technologies". In the teaching methods of foreign languages such technologies are based on the communicative-activity approach. The pedagogical technologies of teaching foreign languages can be classified based on different methodological principles, namely: according to the place in the organization of educational process, under the methodological approaches to their development and application, according to the subjects of the educational process, under the level of application. A special place among them belongs to instrumental technologies.
2. The instrumental technologies of foreign language teaching are considered as a process of development and application of special teaching aids, which is based on the methodology of foreign language teaching and is aimed at achieving educational goals. The instrumental technologies include such interdependent components as 1) technologies of technical teaching aids application; 2) computer learning technologies; 3) telecommunication technologies based on the use of telecommunication means and networks as well as 4) hybrid models of instrumental technology, where the technologies of electronic learning are in their heart.
3. Pedagogical ergonomics is the direction of modern pedagogy, which aims to comprehensive study and design the pedagogical activities of lecturer and students in the system "educator – student – learning environment" to ensure its effectiveness and optimality. These features permit the use of ergonomic approach to design education environment for intensive learning foreign language by means of digital technologies. The effectiveness of the application of pedagogical technologies of foreign language teaching depends on the appropriate design of the learning environment, where the activities of teaching and studying take place in external and internal plan. Designing the learning environment from the standpoint of pedagogical ergonomics requires the construction of a special

language environment for students – material and virtual. This requires taking into account the production, sanitary, anthropometric, psychophysiological and aesthetic factors of study work, which is organized using pedagogical technologies of foreign language teaching including instrumental technologies.

4. The widespread use of multimedia teaching aids and instrumental technologies based on computer makes it possible to properly design the workspace of foreign language teaching in the physical or virtual language laboratory in order to achieve the required level of functional comfort for teachers and students. In this purpose it should consider organization of physical space, availability of the necessary set of computer equipment and technical teaching aids, pedagogical software, rhythm of study work, mode of study activities (synchronous, asynchronous), available opportunities in the use of educational Internet resources. In any case, design of the process of foreign language learning by means of instrumental technologies should be realised through the prism of functional structure of the system “lecturer – student – learning environment”, and to do the ergonomic analysis of the learning environment in two directions – from human requirements to technical teaching means of learning and the conditions of their optimal use, and vice versa – from the requirements of instrumental technologies and conditions of their operation to a human.
5. Degree of influence of instrumental technologies on the educational environment of foreign languages learning can be defined with help of ergonomic criterion, which estimates three main factors – technological, labour and organizational ones. Ergonomic analysis of the level of functional comfort of students in teaching foreign languages with the use of instrumental technologies can be conducted using the method of expert evaluations and special expert card.

The positive dynamics in the levels of ergonomics obtained as a result of approbation of the method of learning environment design for teaching foreign languages by means of instrumental pedagogical technologies allows us to consider it as appropriate and effective one.

Given the fact that in a modern digital society, new technological approaches are constantly being developed, the prospect of further research seems in the development of a methodology for the use of smart-technologies, augmented reality technologies, technologies for mobile learning for foreign language teaching.

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