The formation of educational environment in foreign language training of energy engineering students by means of project technology

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Abstract. The article deals with the results of experimental work concerning the educational environment formation that is focused on the foreign language training of future energy engineering students. Project learning technology is chosen as the means of formation. A model of the educational environment for the metalanguage studying of the speciality of energy engineering students has been developed. In the educational process, educational projects with elements of professional orientation were implemented in accordance with the subject of the discipline "Business Foreign Language", and the language abilities and internal potential of students were taken into account. The preparedness of energy engineering students to integrate knowledge of professionally oriented disciplines into a foreign language environment for solving project tasks of communicative nature has been determined. According to the results of the pedagogical experiment, it was established that in the process of project activity the mastering level of lexical and speech competences as the components of foreign language competence of students has significantly increased. The developed educational environment is characterized by differentiation, individuality, independence, autonomy, informativeness, creativity, which allows to create the necessary conditions for successful learning of foreign language, development of creative thinking, communicative skills of energy engineering students, formation of foreign, communicative, professional, informational, project, research competencies.

1. Introduction

International integration activities, scientific and technological developments and the latest technologies in the field of modern energy, employment opportunities or advanced training in a foreign-language environment, etc. – all these processes extend the range of the professional range of new generation engineers of energy. Accordingly, new requirements are set for technical educational institutions for the

training of students for higher education in the speciality 141 "Electric power engineering, electrical engineering and electromechanics".

The energy labour market needs the competent professionals who are able to solve the engineering problems innovatively and creatively. The future energy engineering students must be ready to develop and improve professional knowledge by foreign languages for the purpose of self-realization in today's conditions, the future challenges of scientific and technological progress. All this actualizes the problem of mastering the foreign language knowledge at such level that would allow them to use them spontaneously during engineering activities. The possible solution to this problem is by making adjustments to the organization of the educational environment, which provides training for future professionals in the energy sector. It is necessary to form an individual space for the disclosure and development of students' speech abilities, the formation of foreign language professional competence by educational technologies. In the process of their selection, we should take into account the specific activity sphere of specialists in the energy sectors.

Project technologies are effective for acquiring and expanding foreign language knowledge independently, close to design as a type of engineering activity ([9], [25], [34]).

The problem of implementation the project technologies into the process of foreign language training has attracted the attention of many researchers and found a partial solution in the following aspects:

– teaching English to students of technical college on the basis of modular design methodology ([6], [14], [32], [39], [40]);

– English-language training of future programmers according to the design methodology in combination with information technologies ([36], [37], [38]);

– creation of professionally oriented projects by postgraduate students on the basis of German-language texts ([12]);

– project methods of learning a foreign language in the context of modern pedagogical technologies ([15], [17], [43], [47]);

– typology of projects in foreign language teaching ([26]);

– features of the project methodology in the process of forming the foreign language communication skills ([13]).

The scientific works of these scientists outline the problem in general. We believe that it is necessary to specify the feasibility of using the project technologies in the educational process and on their basis the possibility of forming the foreign environment for studying the metalanguage of the speciality 141 "Electric power engineering, electrical engineering and electromechanics".

Viacheslav M. Oleksenko stresses that for the training of future students in engineering specialties should be created a "development technology based on the scientific concept of learning, which would educate the individual in activities combining individual, group and frontal forms of work, contribute to improving the quality of the pedagogical process, be aligned with the main provisions of the Bologna Declaration" ([24], p. 5). The innovative pedagogical technology developed by the scientist is called student-based and, in our opinion, is related to the project technology, as it focuses on the personality of the applicant for higher education and the ability to acquire relevant knowledge in self-independent activity. We believe that the project technologies can ensure the acquisition of up-to-date knowledge for future activities, despite of the individual or collective character of execution. These technologies are considered as pedagogical technologies of the 21st century. Because learning through them enables the formation of an individual, who won't be lost in the circumstances of a rapidly changing society ([26], p. 58) and the design methodology combines "the best achievements of communicative and problem methods of foreign language teaching, creates optimal conditions for effective foreign-language communicative and cognitive activity of students" ([12], p. 4).

2. Experimental methods

The pedagogical experiment of the educational environment formation for foreign language training of future power engineers by means of design technology was carried out on the basis of a Separated Subdivision of the National University of Life and Environmental Sciences of Ukraine (SS NULES of

Ukraine) “Berezhany Agrotechnical Institute”. The study was conducted in the first semester of academic year 2018-2019. It was attended by two groups of undergraduates in the first year of speciality 141 “Electric power engineering, electrical engineering and electromechanics”. The research was conducted in the practical classes and extracurricular activities of students in the discipline “Business German”. The study of the topics of content modules was based on the use of design and ICT. Forms of evaluation of acquired knowledge were also project-oriented. Such actions are due to the need of creating an effective educational environment for intensive and deep study of metalanguage lasting one semester.

The experimental work consisted of 5 stages, in the process of which a number of methods of scientific research were used (analysis, synthesis, observation, survey, comparison, modeling, pedagogical experiment, methods of mathematical statistics). We offer a description of the stages of experimental research.

The first stage was theoretical. Its purpose was to study the state of foreign language training of energy students and to determine the conditions created in the SS NULES of Ukraine “Berezhany Agrotechnical Institute” for competent mastery of metalanguage. It is established that the process of professional training of future energy engineering students involves the study of a professional foreign oriented language of as a compulsory educational component.

The formation of practical foreign skills and ability in the metalanguage acquisition of future speciality ensures the study of the academic discipline “Business foreign language”, which includes 4 credits. Foreign competence, as the final result of the acquisition of foreign language curriculum, belongs to the general competences, which must be mastered by the students Master’s degree of the speciality 141 “Electric power engineering, electrical engineering and electromechanics” [31]. However, the foreign-language training of students is not limited to the program requirements, but extends beyond it. It should be noted that the influence of a foreign language is multifaceted and extends to the study of vocational subjects. Foreign-language elements are present in all fields of educational process of students’ preparation of speciality “Electric power engineering, electrical engineering and electromechanics”, in particular:

– international activity of SS NUBIP of Ukraine “Berezhany Agricultural Technical Institute” (cooperation with Vienna University of Natural Resources and Natural Sciences, the Wieselburg Research Centre for the Production and Use of renewable Energy, internships in Switzerland on the enterprises, which are automated by modern electrical equipment, short-term studies at Berne University of Applied Sciences according to Agrimpuls programme, meetings with foreign delegations, etc.);

– library collections (scientific and technical literature, professional journals, encyclopaedias and energy directories of foreign-language publishers);

– asubstantive content of disciplines of general and vocational training with a relevant information from the foreign sources;

– visual aids (information panels using foreign abbreviations, posters showing the technical characteristics of European energy facilities, catalogues of electrical equipment of international firms);

– material and technical infrastructure (modernized laboratory workplaces with modern electrotechnical and electromechanical equipment, electrical apparatuses of foreign manufacture) etc.

Foreign-language means, combined with ICT, project and interactive technologies, and practical methods, problem-based and inverted-learning techniques, make it possible to achieve the unity of all educational objectives: training, developmental practical, educational. Binary classes in foreign language and vocational training disciplines are favourable pedagogical condition for implementation of interdisciplinary integration of foreign and professional (vocational) knowledge of future energy engineering students. The creation of educational projects, writing the course papers and master’s degree works are accompanied by processing of foreign materials for the disclosure and substantiation of research topics with up-to-date information. Active participation in scientific and practical seminars, international conferences and energy forums is possible thanks to the ability of energy engineering students to use scientific and technical literature in a foreign language to prepare reports on subject of the study, the ability to present the results of scientific work in a foreign environment. Knowledge of

the metalanguage of the speciality expands the range of possibilities of practical training, allows an internship at power establishments abroad, thus, it contributes to the acquisition of European experience in the field of power engineering and to the assessment of the level of professional foreign knowledge.

Thus, a foreign language is an auxiliary mean of organizing and conducting lectures, practical and laboratory exercises by professors and a way of carrying out educational, scientific, research, industrial, cultural and educational work by students.

The basis for metalanguage acquisition is formed on the basis of the academic discipline "Foreign language in vocational training", which is studied by the students of Bachelor's degree at the first year of study. The postgraduate students learn "Business foreign language", the subject of which is also vocational. These subjects are complementary and interdependent. Without knowledge of one subject, learning another one is problematic, but it is possible. Therefore, the metalanguage of the baccalaureate specialty is a peculiar tool for acquiring foreign skills and business communication skills in Master's degree. There is a large gap between the two subjects, which has a significant impact on the gaining and acquisition of new foreign knowledge. Therefore, the second stage of the experimental work was diagnostic and evaluative. On-line testing was conducted to determine the level of formation of lexical and grammatical competencies of the students of Master degree. Test tasks are available at https://onlinetestpad.co/ua/test92000-test-z-nimeckoi-movi. According to the results of the test control it is established that the vocabulary in 76% of students is passive, practical skills are manual, grammatical material needs to be revised. The average level of residual knowledge is observed in 20% of postgraduate students. Only 4% of future energy engineering students are able to acquire a foreign language at a higher level. Such quantitative indicators indicate the need in leveling and improving the students' knowledge.

The third stage of experimental work was based on the observation of the activity of undergraduates in practical classes, their productivity in all types of speech activity. On the basis of observation, the positive aspects of students' project work were established, in particular, increasing motivation in foreign language training, interest in performing professionally-oriented tasks. Also, the problems were found during the process of creating thematic projects by the future energy engineering students. These include: confusion in a foreign language information environment and passivity in teamwork due to the insufficient vocabulary, practical skills of foreign language proficiency. The main focus was on the use of design and information and communication technologies. These technologies are able to provide activation of processes: repetition, generalization, studying, acquisition, and systematization, application of foreign knowledge during practical lessons, and extracurricular work. To implement these processes effectively, teaching materials (https:///www.youtube.com/watch?v=QdpAJcuYX18) was used in German with English subtitles. The video watching contributed to the training and improvement of listening and speaking skills. The ability to carry out the educational projects creatively, the ability to understand them by audio-visual tools and the presentation them to the audience are depended from the level of their skills formation.

Concerning the information above, a research hypothesis has been formulated: the educational environment for foreign language training of future energy engineering students will be effective if its molding tool is a project-based learning technology. This process based on the implementation of project activities by postgraduate students, it provides conditions for acquiring a range of personal competences: foreign, communicative, informational, professional, project, research. To confirm the correctness of the hypothesis at the fourth stage of research, a model of the educational environment for foreign language training of energy students was developed and a pedagogical experiment was conducted to test it.

The purpose of the pedagogical experiment was to determine the effectiveness of project the educational environment for foreign language training of future energy engineers by means of design technology. For conducting the pedagogical experiment two groups were created: experimental and control. Each group consists of 25 students. Undergraduates of the experimental group studied "Business German" according to the project methodology, students of the control group – according to traditional teaching methods: communicative, grammar-translation, audiolingual, situational. Although the process

of acquiring foreign language knowledge took place in different ways, the end result was aimed at achieving a single goal – mastering the metalanguage of the speciality, the formation of readiness to solve professional problems by means of a foreign language.

The disadvantage of the pedagogical experiment was the limited duration. This is due to the requirement programs, according to which "Business Foreign Language" is studied only one semester. Nevertheless, within the framework of the experiment it was possible to form foreign language project skills and skills of undergraduates, to develop a number of professionally oriented educational projects in a foreign language.

The final stage of the experimental work involved the implementation of control and evaluation measures. They allowed to reveal the level of formation of foreign language knowledge of future energy engineering students in the created educational environment by means of project technology. Using the comparison method, the data of the control and experimental groups were compared.

Based on the data obtained as a result of pedagogical research, we offer a description of the educational environment for foreign language training of future energy engineers.

3. Results

Project technology is chosen as a mean of creating an educational environment, and project activity is chosen as a way of carrying out the foreign language training. The position of the Roman M. Horbatiuk is taken as the basis, who approves that "project technologies are one of the most promising and effective innovative technologies, allowing to develop a wide range of competences in subjects of study" ([7], p. 35).

In addition to the researcher's opinion, it should be noted that such competences in future energy engineering students are linguistic, lexical [10], phonetic, speech, pragmatic, sociocultural. They are components of foreign competence, which means the integral character of the individual, who possesses a complex of foreign language knowledge, practical skills and ability whose level of formation is determined by the ability to decide educational, social and professional tasks by means of a foreign language in all types of speech activity of a receptive and productive nature, as well as readiness to implement of professional mobility by means of a foreign language ([8], p. 274). The focus on project technologies is due to the following factors:

1) the orientation of pedagogical technology towards the personality of student, his/her natural abilities and interest in learning a foreign language, and his or her internal potential to carry out the defined tasks, both constructive and creative;

2) it is desirable to develop project skills necessary not only for the creation of foreign language product in the course of training, but also for the acquisition of practical project skills during the implementation of professional engineering duties in the future, for example the project of models of electrical or electromechanical equipment, etc. Project technologies bring together two processes: the development of knowledge, skills and abilities and their practical use in future professional activities. For project work as a form of solving foreign tasks by students and a variety of engineering activities as a way of performing professional duties in the energy industry, are characterized by common features:

– motivational and personal – interest, initiative, creativity and ingenuity in solving the problems;

– effective – individual, collective, work in pairs;

– organizational and executive – planning, implementation and presentation;

– resulting – project as a result of students' educational work and a product of constructive activity of energy engineering students.

3) the autonomy of the training which is necessary for the students of Master degree, who study according to the individual plan in connection with employment. Project technologies offer students the freedom of educational activities, starting from the choice of research topic, information sources, the way of implementation and presentation of project work. There are no instructions for tasks of a project nature – and there are no clear limitations in their solution. During the implementation of the project, students are able to manage the learning process independently, which is characterized by self-regulation, reflectivity and consciousness, motivation, cooperation, use of convenient learning strategies

([41], pp. 94–97). This approach to the study of a foreign language is characterized by accessibility, autonomy, initiative, motivation, productivity and intensity, because it occurs through the students' personal activities, taking into account individual interests, internal motives, level of foreign-language knowledge, etc.

3.1. Implementation of problem-based learning and developed projects

Taking into account the factors that were substantiated above and own experience the model of the educational environment for foreign language training of future energy engineering students is developed. In figure 1 shows its visual image.

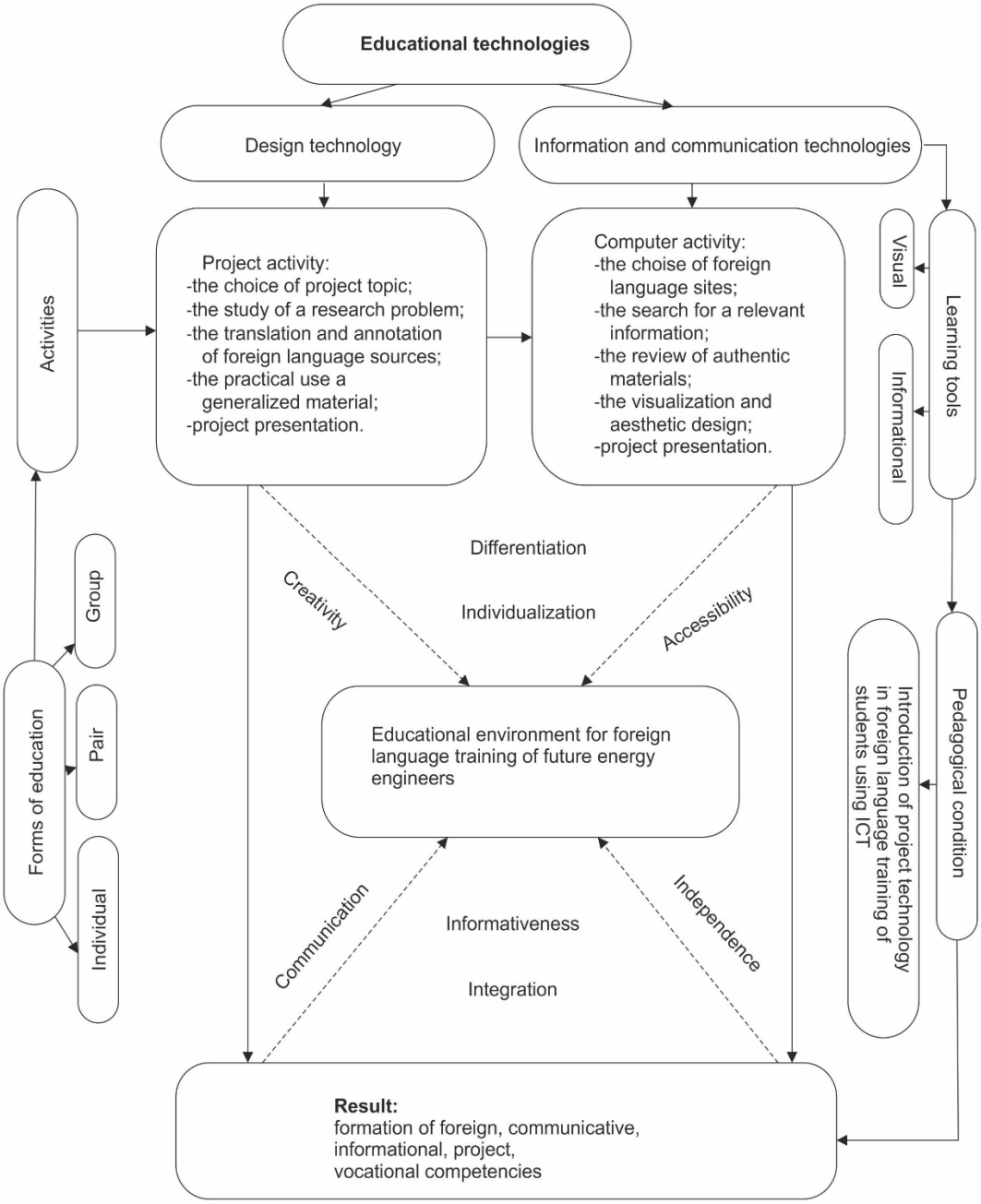

Figure 1. The educational environment model for foreign language training of future energy engineering students.

The definitional characteristics of the developed model are differentiation, individualization, accessibility, autonomy, integration, informativeness, communication, and creativity. Project and computer activities, individual work, work in pairs and groups on a thematic project; informational and visual teaching tools belong to the structural elements of the model. It is based on the pedagogical condition of implementation of project technology into the foreign-language training of students using ICT. These technologies provide for the substantive and linguistic integrated training of future energy engineering students: acquisition of general language and vocational knowledge. In our research, the informational and communication technologies are considered from the following points:

1) Moodle platform for mastering the program requirements of the discipline "Business German" (https://www.nipbati.nubip.edu.ua/mod/page/view.php?id=11621) and foreign language training by levels (https:///www.dw.com/de/deutsch-lernen/deutschkurse/s2068, https://ww.deutsch-lernencom/virtual/e_test_kurz_leitung.php);

2) foreign professional sites (https://wwww.absolventa.de/jobs//channelietechnik/ma/beruf, https://www.ernerbare-energien.de/EE/Navigation/DE/Home/home.html);

3) electronic dictionaries (https://www.duden.de/woerterbuch, https:///www.linguee.de/);

4) test tools (https://wwww.goethe.de/spren//kup/tsd.html, https://www.sprcaf.fede/spracht-deutsch.htm).

The above positions, selected taking into account the scientific approaches of researchers to the issues of communicative and integrated foreign language learning ([3], [5], [16], [18], [33]), the use of ICT ([2], [4], [11], [23], [28], [44], [45], [46]), e.g. Moodle ([1], [19], [20], [21], [22], [27], [29], [30], [35], [42]).

We offer a description of the project activities of energy engineering students of SS NULES of Ukraine "Berezhany Agrotechnical Institute" in the discipline "Business German" and a description of the developed projects in the metalanguage speciality 141 "Electric power engineering, electrical engineering and electromechanics".

It should be noted, that the course and end result of the students' project activity depends primarily on the ability to acquire the vocabulary practically and use it actively in non-standard tasks of vocational and communicative nature. Knowledge of foreign language is based on foreign language vocabulary. The vocabulary minimum of future energy engineering students is formed by commonly-used vocabulary, professionalism, technical terms and abbreviations of energy objects, electrical and electromechanical equipment, electrical apparatuses and appliances. From our own experience, learning foreign words is very problematic for energy students. According to the results of the survey, 66% of postgraduate students use the new words; 24% of students remember lexical units, associating them with the names of objects, phenomena, processes, etc., whose foreign meaning has already been learned; 10% of students learn vocabulary by adding them into phrases, sentences, mini-dialogues. This enrichment of students' vocabulary is typical of the traditional methods of foreign language learning. The project technology expands the ability to form the vocabulary of future energy engineering students and allow not only add it with new words, but also update the learned lexical material in memory, repeat the passive vocabulary. During the search for the necessary information, independent work on foreign-language sources, students find additional lexical units, which are not the key to the project's topics disclosure, but important for the general vocabulary. The presentation of the result of project activities allows activating the words that were learned in practice.

In order to test the effectiveness of the project technology as a means of forming lexical competence of future energy engineering students, the training project "Thematic mini-dictionary of technical terms" has been implemented in educational process of the technical terms. Masters of the control group were studying the foreign words according to traditional methods (translation, recitative-reproductive, productive-communicative exercises), and experimental – in the form of independent research work on authentic materials of scientific and technical nature.

The students' task of the testing group was to learn the selected vocabulary, which is the key for the themes learning "Alternative energy sources", "Energy saving technologies". The postgraduate students

of experimental group were asked to work out the vocational articles independently, write the most commonly used technical terms, find their Ukrainian equivalents and sort them by subject.

You can find practical application of learned vocabulary in receptive and productive types of speech activity during the implementation of the thematic project "Energy saving technologies based on alternative sources", which covered two stages: class and extracurricular work. The class work included the formation of three mini-projects based on the training material of the informative module "Professional activity of future energy engineering students", which is the obligatory component of the subject "Business foreign language". For activation of thematic thesaurus, practical skills of audition, speaking, reading, writing mini-projects on the theme has created: "Business card", "At energy enterprise", "Contract for purchase and sale of solar panels". The work on the project ensured the interdisciplinary integration of students' vocational and foreign knowledge. We offer fragments of training projects, which were worked on by postgraduate students of "Electric power engineering, electrical engineering and electromechanics" speciality.

Mini-project "Business Card" (figure 2) was aimed at forming communicative abilities of students, vocational and business qualities, practical skills of conducting a meaningful, grammatically correct monologue with transition to spontaneous dialogue.

Mini-project "Business Card"

Objective: The aim is to teach foreign-language knowledge in practice and develop skills in group work.

Implementation condition: Check out the business card of the head of "Centre of Bioenergy". Working in pairs, describe the energy specialist on the basis of the data specified in the business card. Create a personal business card, indicating surname, first name, position, place of work, address of the institution, contact details. Presenting yourself to future colleagues.

bürger-energie bodensee

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Figure 2. Mini-project fragment "Business Card".

The execution of the mini-project "At the Power factory" was carried out in two stages: 1) viewing of foreign-language material followed by communication (figure 3); 2) creating an interactive online presentation in Google Slide using the information presented on www.buergergergiebodense.de (figure 4). The main objective of the first phase of the project was to develop foreign language video skills with full understanding and subsequent communication. The second phase of the project was carried out in compliance with the following requirements:

– learning the thematic headings and their distribution among the project participants for further justification;
– individual search of up-to-date information on foreign site;
– limitation of test content filling, focus on key concepts;

– preference for visual representation;
– presentation of the results of the work in a monological form with open discussion.

Step 1.

Mini-project "At the Energy Enterprise"

Objective: The aim is to teach to comprehend the foreign information and to increase its use in foreign communication situations.

Implementation condition: See video link:

https:///wwww.youtube.com/watch?v=TaIzGjoRzPo

Take notes of what you hear. On the basis of the video, discuss the theme "Energy-saving technologies. Solar panels: types and range of applications".

Figure 3. Mini-project fragment "At the energy enterprise".

Step 2.

Mini-project "At the Energy Enterprise"

Objective: The aim is to develop the practical skills in working with authentic foreign material, to operate vocational vocabulary in a foreign communicative environment.

Implementation condition: create an online presentation using foreign sites, for example www.buergergiebodenseede and present it in front of the audience.

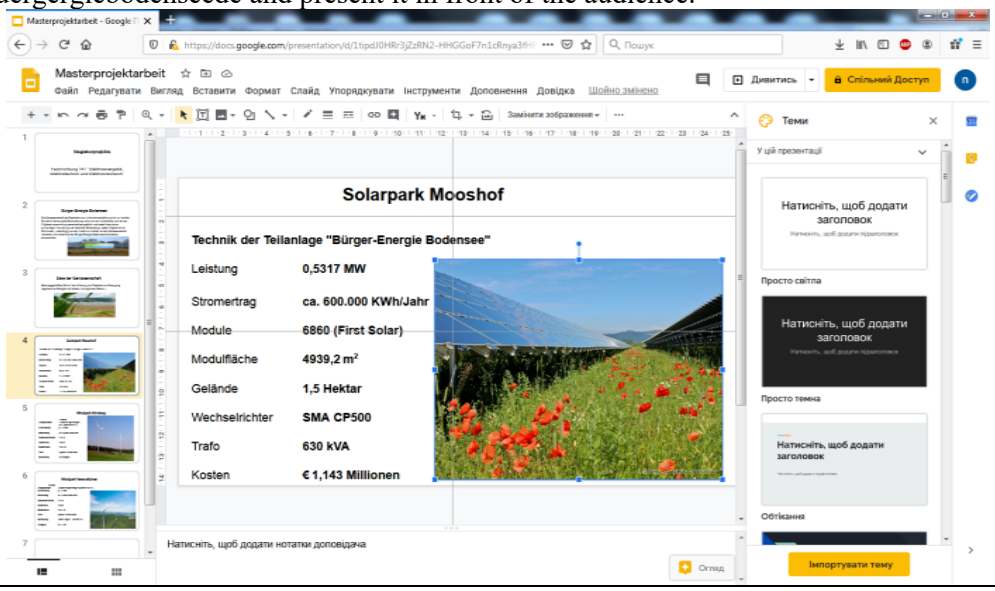

Figure 4. Mini-project fragment "At the energy enterprise".

Following the algorithm of the sequence of actions with the requirements consideration gave us the opportunity to determine the students' skills to orientate in foreign informational environment, to extract the main material, the ability to reproduce a text, the level of formation of all types of speech activity of future energy engineering students, the readiness to conduct the spoken communication successfully on the basis of independently studied unadapted foreign materials without prior study, to discuss with classmates spontaneously, to express personal opinions easily. On the basis of the results of the presented projects in the form of monologues with transition to polylog, the postgraduate students evaluated their knowledge and practical skills independently, determined the level of proficiency in foreign language acquisition in the group, identified the drawbacks that needed to be eliminate in the foreign language training process.

The mini-project "Contract for purchase and sale of solar panels" was carried out with the aim of forming business documentation skills of future energy engineering students, writing skills (figure 5).

The students' work in groups and work in pairs during the practical classes concerning the creation of the above-mentioned mini-projects ensured the formation of practical skills and abilities which are necessary for realization of individual project "Energy saving technologies on the basis of alternative sources" during the extracurricular work. The postgraduate students substantiated and disclosed the research topic in the training projects, the names of which are: "Energy saving technologies at enterprise", "Energy saving technologies of individual and general consumption", "Electric energy saving as a way of energy saving", "Alternative energy sources" and others. The creation of individual projects and their presentation ensured the formation of foreign, communicative, informational, project and vocational competences of postgraduate students as integral components of professional competence of energy engineering students.

Mini-project "Contract for purchase and sale of solar panels"

Objective: The aim is to teach students to orientate in a foreign text during the process of first reading and to find the necessary information, to develop reproductive and creative abilities.

Implementation condition:

1. Read the agreement.

Agreement of sale

We are the persons, who the signed below,

On the one hand, the head of the Bürger-Energie Bodensee eG company Andreas Klatt, whose name is "Supplier", and on the other hand the head of the company "Ökoenergie" – Victor Kondratenko, whose name is "Receiver" concluded a contract for the purchase and sale of solar panels. The supplier will undertake to deliver the delivery after he receives the money. After the receiver gets the account, he has to pay for the goods ordered in three days.

Date of signature	Date of signature
Signature	Signature
Andreas Clatt	Victor Kondratenko

2. Make your own agreement text yourself, pay attention to the model.

Figure 5. Fragment of the mini-project "Contract for purchase and sale of solar panels".

3.2. The effectiveness of the proposed approach

Checking the feasibility and effectiveness of the use of design technology in foreign language training of future energy engineers were control measures.

To determine the level of proficiency in lexical and speech competences as a part of foreign competence such diagnostic forms were used: word dictation that required not only the translation of learned words, but also the words writing which are associated with the theme and their introduction to the phrase. Monologue and dialogue speech was conducted according to the project theme. Based on the checking results of written works and the control of oral speech, it is determined that the level of thematic vocabulary learning and its practical application in communication among the students of the experimental group is higher than in the postgraduate students of the testing group (table 1 and 2).

Table 1. Formation levels of lexical competence of future engineers.

Category of groups	Number of future engineers (N)	Levels of formation					
		High		Medium		Low	
		N	%	N	%	N	%
Control group	25	6	24	12	48	7	28
Experimental group	25	8	32	14	56	3	12

The data presented in the tables show that in the conditions of the innovation environment, foreign

language training of future energy engineers was successful.

Table 2. Levels of formation of speech competence of future engineers.

Category of groups	Number of future engineers (N)	Levels of formation					
		High		Medium		Low	
		N	%	N	%	N	%
Control group	25	4	16	12	48	9	36
Experimental group	25	7	28	14	56	4	16

Due to the introduction of the developed model in the educational process in the levels of lexical and speech competence of future energy engineers there were positive changes due to the use of project and information and communication technologies. The technology data provided motivation to learn a foreign language, independent work, access to relevant information sources, individualization and differentiation of project tasks, formation of personal and professional qualities and a range of basic competencies. In particular, the number of future energy engineers with a high level of command of foreign language vocabulary increased from 24% to 32%. The number of undergraduates with an average level of knowledge of foreign words increased from 48% to 56%. There is a decrease in the number of students with a low level of vocabulary from 7% to 3%. 28% of future energy engineers are able to perform foreign language professionally-oriented communication at a high level. At the average level, 56% of students can speak a foreign language. Low level of oral speech is typical for 16%. Compared with the control group, the number of undergraduates with a high level of speech competence increased by 12%, with a medium level – 8%, with a low level – 5%.

The results of the pedagogical experiment prove the effectiveness of the created educational environment for studying the metalanguage of the speciality. Additionally, the skills acquired by undergraduates in the process of foreign language training were revealed. The level of their formation is determined on the basis of objective self-assessment of students (Table 3).

Table 3. Quantitative indicators of self-assessment of formed skills in the process of foreign language training.

Competence	"My Success" Questionnaire					
	Project learning technology			Traditional teaching methods		
	High level	Medium level	Low level	High level	Medium level	Low level
Free to navigate in a foreign language information space	64 %	32 %	4 %	44 %	48 %	8 %
Work independently with foreign electronic resources	64 %	32 %	4 %	44 %	48 %	8 %
Understand authentic professional materials	56 %	36 %	8 %	36 %	48 %	16 %
Annotate the content of foreign language professional texts	56 %	36 %	8 %	36 %	48 %	16 %
Practically use the obtained information	56 %	36 %	8 %	36 %	48 %	16 %
Perform non-standard tasks	72 %	20 %	8 %	28 %	44 %	28 %
Think creatively	64 %	24 %	12 %	56 %	36 %	8 %
Communicate spontaneously without prior preparation	28 %	56 %	16 %	16 %	48 %	36 %

The data presented in the table show that project technology provides a higher level of practical skills of undergraduates compared to traditional methods of teaching a foreign language, which are necessary

to master foreign language, communication, information, design, professional competencies of students.

4. Conclusions

According to the results of experimental work, it has been established that for the successful acquisition of foreign language knowledge, a special educational environment should be functioned. This need is caused by the following factors: the specifics of a foreign language as a discipline; features of theoretical mastering and practical application of foreign language knowledge; priority position of "Business Foreign Language" among professionally-oriented subjects; personal potential of energy students. The pedagogical experiment in studying the "Business German", which was based on the use of project technology in combination with information and communication technologies, gave the positive results. In particular, the number of future energy engineering students who are able to actively operate with vocabulary and skillfully use lexical items, depending on the context, increased to 16%. The number of undergraduates who can communicate using foreign language for a professionally oriented topic in non-standard and unpredictable communicative situations has increased to 20%. Thematic projects which were presented by undergraduates to the audience: "Business card", "At the energy company", "Contract for purchase and sale of solar panels", "Energy-saving technologies in production", "Energy-saving technologies for individual and general consumption", "Energy saving as a way of energy", "Alternative energy sources", testify to the positive dynamics in foreign language training of future energy engineering students and the correct choice of design technology for learning a foreign language. During the project activity, the level of foreign language acquisition competence of undergraduates significantly increased, skills of independent work with authentic foreign language information were formed, the ability to operate it practically in receptive and productive types of speech activity was intensified.

The research hypothesis is confirmed and the efficiency of the developed model of formation of the educational environment for foreign language training of future energy engineering students by means of project technology is proved. The developed educational environment by means of project technology allows: to reveal and comprehensively develop language abilities, communicative abilities and skills of each applicant of higher education in speciality 141 "Electric power engineering, electrical engineering and electromechanics"; to intensify the educational and cognitive activities of students and expand their motivational sphere; to provide differentiation and individualization of acquisition of foreign language knowledge.

Without taking into account the processes above and the use of active learning technologies, achieving positive results in foreign language training is problematic.

References

[1] Abdula A I, Baluta H A, Kozachenko N P and Kassim D A 2020 Peculiarities of using of the Moodle test tools in philosophy teaching *CEUR Workshop Proceedings* **2643** 306–20
[2] Attewell J 2005 Mobile technologies and learning: A technology update and m-learning project summary (London: Learning and skills development Agency) p 19
[3] Bentley K 2010 The TKT Teaching knowledge test course. CLIL module. Content and language integrated learning (Cambridge: Cambridge University Press) p 124
[4] Brett P 1998 The rationale for the usefulness of multimedia for language learning *Journal for English language teacher education* **12** 11–5
[5] Coyle D, Hood P and Marsh D 2010 CLIL: content and language integrated learning (Cambridge: Cambridge University Press) p 184
[6] Holiver N, Kurbatova T and Bondar I 2020 Blended learning for sustainable education: Moodle-based English for Specific Purposes teaching at Kryvyi Rih National University *E3S Web of Conferences* **166** 10006 URL https://doi.org/10.1051/e3sconf/202016610006
[7] Horbatiuk R M 2009 Theoretical bases of project training of future engineers-teachers *Youth and market* **49** 35–42
[8] Horbatiuk R M and Bilan N M 2018 Formation of foreign language competence of future energy engineers *Modern information technologies and innovative teaching methods in training:*

methodology, theory, experience, problems **52** 272–6
[9] Horbatiuk R, Voitovych O and Voitovych I 2020 Formation of project competence of future environmentalists *E3S Web of Conferences* **166** 10026
[10] Kazhan Yu M, Hamaniuk V A, Amelina S M, Tarasenko R O and Tolmachev S T 2020 The use of mobile applications and Web 2.0 interactive tools for students' German-language lexical competence improvement *CEUR Workshop Proceedings* **2643** 392–415
[11] Kingsley A 2017 Information Communication Technology (ICT) in the Educational System of the Third World Countries as a Pivotal to Meet Global Best Practice in Teaching and Development *American Journal of Computer Science and Information Technology* **5** URL https://doi.org/10.21767/2349-3917.100010
[12] Kirshova O V 2008 Methodology of training master`s degree students to create professionally-oriented projects on the basis of texts in German *Thesis*
[13] Klak I 2005 Peculiarities of project methodology implementation in the process of formation of foreign language communication skills *Foreign languages* **6** 11–2
[14] Konovalenko Yu, Garkavenko S, Derkach T and Morgulets O 2020 Demand and Learning Environment to Provide English-Language Learning at Technical Universities in Ukraine *CEUR Workshop Proceedings* **2732** 996–1011
[15] Lemeshchenko-Lagoda V, Kryvonos I and Kolodii O 2020 Integration of information and communication technologies into the process of learning the course of English for specific purposes as one of the requirements for sustainable future development *E3S Web of Conferences* **166** 10005
[16] Littlewood W 2002 Communicative language teaching. Language teaching library (Cambridge: Cambridge University Press) p 108
[17] Medvedeva L I 2011 Project methodology for learning a foreign language in the context of modern pedagogigal technologies *Scientific notes of Ternopil National Pedagogigal University V Hnatyuk. Series: Pedagogy* **4** 130–4
[18] Merzlykin O V, Topolova I Yu and Tron V V 2018 Developing of Key Competencies by Means of Augmented Reality at CLIL Lessons *CEUR Workshop Proceedings* **2257** 41–52
[19] Mintii I S 2020 Using Learning Content Management System Moodle in Kryvyi Rih State Pedagogical University educational process *CEUR Workshop Proceedings* **2643** 293–305
[20] Mintii I S, Shokaliuk S V, Vakaliuk T A, Mintii M M and Soloviev V N 2019 Import test questions into Moodle LMS *CEUR Workshop Proceedings* **2433** 529–40
[21] Morze N, Varchenko-Trotsenko L, Terletska T and Smyrnova-Trybulska E 2021 Implementation of adaptive learning at higher education institutions by means of Moodle LMS *Journal of Physics: Conference Series* In press
[22] Nechypurenko P P and Semerikov S O 2017 VlabEmbed – the New Plugin Moodle for the Chemistry Education *CEUR Workshop Proceedings* **1844** 319–26
[23] Neo M and Neo K T K 2001 Innovative teaching: Using multimedia in a problem-based learning environment *Educational technology and society* **4** 19–31
[24] Oleksenko V M 2008 Theoretical and methodical bases of realization of innovative technologies in preparation of the future experts of engineering specialties *Thesis*
[25] Pavlenko M and Pavlenko L 2021 Formation of communication and teamwork skills of future IT-specialists using project technology *Journal of Physics: Conference Series* In press
[26] Polat E S 1999 New pedagogical and information technologies in the education system (Moscow: Academy) p 224
[27] Polhun K, Kramarenko T, Maloivan M and Tomilina A 2021 Shift from blending learning to distance one during the lockdown period using Moodle: test control of students' academic achievement and analysis of its results *Journal of Physics: Conference Series* In press
[28] Ratheeswari K 2018 Information Communication Technology in Education *Journal of Applied and Advanced research* **3** 45–7 URL http://dx.doi.org/10.21839/jaar.2018.v3iS1.169
[29] Rice W 2006 Moodle: E-learning course development (Birmingham: Packt Publishing) p 256

[30] Rice W 2007 Moodle teaching techniques: creative ways to use Moodle for constructing online learning solutions (Birmingham: Packt Publishing) p 192
[31] Separated Subdivision of National University of Life and Environmental Sciences of Ukraine "Berezhany Agrotechnical Institute" 2018 *Educational and professional program of higher education Electric power engineering, electrical engineering and electromechanics of the Second (master`s) level of higher education in the speciality 141 Electric power engineering, electrical engineering and electromechanics in the field of knowledge 14 Electrical Engineering. Qualification Master of Electric power engineering, electrical engineering and electromechanics* URL https://www.bati.nubip.edu.ua/index.php/en/osvitni-prohramy-2018
[32] Shalatska H M, Zotova-Sadylo O Yu and Muzyka I O 2020 Moodle course in teaching English language for specific purposes for masters in mechanical engineering *CEUR Workshop Proceedings* **2643** 416–34
[33] Shavkun I H, Dybchynska Y S, Yudina O V, Bukharina L M, Shmygol N M and Shmygol Ye I 2021 Exploring the experience of integrated teaching of the management core courses in a foreign language based on ICT use *Journal of Physics: Conference Series* In press
[34] Shuhailo Ya V and Derkach T M 2021 Project-based learning for undergraduate engineering students minoring in textile technology and design *Journal of Physics: Conference Series* In press
[35] Stanford J 2009 Moodle 1.9 for second language teaching: engaging online language-learning activities using the Moodle platform (Birmingham: Packt Publishing) p 524
[36] Strilets V V 2010 Project work methods of teaching English to future programmers using information technologies *Thesis*
[37] Symonenko S 2020 Complementing content of English courses for enhancing communication of IT-professionals for sustainable development *E3S Web of Conferences* **166**
[38] Symonenko S V, Zaitseva N V, Vynogradova M S, Osadchyi V V and Sushchenko A V 2021 Application of ICT tools in teaching American English for computer science students in the context of global challenges *Journal of Physics: Conference Series* In press
[39] Tarnopolsky O, Volkova N and Kozhushko S 2020 Sustained English lingua-cultural education: a solution for Ukraine *E3S Web of Conferences* **166** 10004
[40] Titova B V 2001 Modular-project methods of teaching English to the students of technical higher educational institutions *Thesis*
[41] Traub S 2011 Selbst gesteuert lernen im Projekt Anspruch an Projektunterricht und dessen Bewertung aus Sicht von Lehrenden und Lernenden *Journal of Pedagogy* **57** 93–113
[42] Ustinova V O, Shokaliuk S V, Mintii I S and Pikilnyak A V 2019 Modern techniques of organizing computer support for future teachers' independent work in German language *CEUR Workshop Proceedings* **2433** 308–21
[43] Volkova N P, Tarnopolsky O B, Lebid O V, Kabanova M R and Vlasenko K V 2021 Students' computer-based workshops in mandatory classes of English for students majoring in psychology and linguistics: A comparative experimental study *Journal of Physics: Conference Series* In press
[44] Warshauer M 1995 E-mail for English Teaching: Bringing the Internet and computer learning networks into the language classroom (Alexandria: Teachers of English to Speakers of Other Languages) p 158
[45] Yu C 2013 The Integration of Technology in the 21st Century Classroom: Teachers' Attitudes and Pedagogical Beliefs Toward Emerging Technologies *Journal of technology integration in the classroom* **5** 5
[46] Yusuf M O 2005 Information and Communication Technology and Education: Analysing the Nigerian National Policy for Information Technology *International Education Journal* **6** 316–21
[47] Zaitseva N 2020 Developing English presentation skills as a component of collaboration competence for sustainable development *E3S Web of Conferences* **166** 10007