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Integration of lexical approach and project-based learning as teaching methods for a successful acquisition of English specialized vocabulary by non-linguistic students

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Abstract

Introduction. *The article analyses the issue of methodological approaches in the field of teaching specialized English. The aim of the research is to justify the efficacy of the integration of lexical approach and project-based learning as teaching methods for a successful acquisition of English specialized vocabulary by non-linguistic students.*

Materials and Methods. *The study is based on the theoretical method of analysis of linguistic research in specialized English teaching and empirical methods of testing, educational projects and observation. The hypothesis was tested using the method of statistical analysis of the test results and educational projects. The teaching procedure consisted of grammar-translation method in the control group; lexical approach and project-based learning in the treatment group.*

Results. *The most relevant studies on the research problem conducted by the Russian and foreign scholars have been analysed. The authors have substantiated the advantages of lexical approach and project-based learning over a grammar-translation method for specialized vocabulary acquisition which served as the basis for the comparative analysis. The original pre- and post-tests and educational projects as evaluation methods for assessing the progress in specialized vocabulary acquisition have been proposed by the authors. The results of testing and students' projects presentation showed that there had been a gain in students' specialized vocabulary in the treatment group, while in the control group, the dynamics was no as significant. The observation revealed that the students in the treatment group demonstrated knowledge of specialized collocations by using them within the proper context in their written and oral speech exhibiting oral proficiency in spontaneous communication.*

Conclusions. *In conclusion, inferences are made about the expediency of an integrative approach, which combines conventional language learning exercises with interactive pedagogical strategies and an effective methodology for the instruction of specialized vocabulary, particularly specialized collocations.*

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Keywords

Lexical approach; Project-based learning; Non-linguistic students; Specialized English; Grammar-translation Method; Specialized collocations; Oral proficiency.

Introduction

The important role of professionally oriented English for the field-specific activities of future natural scientists and engineers is evident. Professionally oriented written and oral communication skills in English contribute to future specialists' professional competence; they allow them to read many valuable resources, such as educational materials, research papers and industry reports, to communicate confidently with future colleagues, enhancing their professionalism and credibility.

In tertiary educational institutions, the classes of ESP (English for specific/special purposes) give students an opportunity to develop and improve their professional English skills. Specialized terms acquisition, the ability to use the specialized vocabulary in the proper context are the must skills for a graduate of the Institute of Physics.

The improvement of language fluency has always been associated with the increase in vocabulary knowledge. Assuming that vocabulary development is linear scholars and educators focused on the morphological and syntactical aspects of learning vocabulary. Little attention was given to lexical development and its impact on language proficiency.

The importance of vocabulary over grammar has been emphasized by Sc. Thronbury[1] who states that, "without vocabulary, students cannot express themselves much". Vocabulary development in second-language acquisition, and, especially in English for special purposes acquisition, is still relevant today.

In tertiary education environment, ESP teachers face difficulties in finding effective teaching strategies that contribute to the successful acquisition of specialized vocabulary by the learners, their good performance and motivation for study.

A prominent amount of research studies have focused on understanding of how English language learners acquire formulaic knowledge, how collocations are processed and used.

A number of studies based on the use of comparative linguistic analysis (contrastive analysis) for teaching collocations exemplify an improvement of students' ability to translate different kinds of texts through differentiating synonyms in both languages (the native and the target ones) [1–3].

The results of F. Khonamri and S. Roostaee's research show that task-based extensive reading improves learners' depth of vocabulary knowledge [4].

T. I. G. Sneida et al. have found that specific working memory strategies provide learners with a possibility of appropriate learning of collocations and improve learners' speaking performance ("emphasising the first letter of the words using acronyms, visualising the meaning of the word, associating the word with synonyms and antonyms, utilising new words in sentences, studying words through physical action") [5].

Teaching English for Specific Purposes is not a separate discipline, but one of the areas of teaching English, and uses the same general scientific methods - be it the grammatical-translation method or the communicative

[1] Thronbury Sc. *How to teach vocabulary*. Essex: Pearson Education Limited, 2002.

approach. However, the ESP sphere requires greater focus on professionally oriented vocabulary, grammar, discourse, genre, thereby emphasizing its specificity.

Teaching ESP combines both traditional methods of teaching a foreign language (lexical and grammatical, communicative methods) and modern approaches (audio-lingual, game, project methods, lexical approach)[2] [6]. Such a variety of approaches to teaching ESP is explained primarily by the lack of a specific methodology for teaching ESP, as well as the shortage of available professional literature, which does not include proper elaboration of all available topics and vocabulary within a particular specialty [6]. In addition, it is noted that "in Russian-language manuals, the emphasis is laid on the content approach, not the language one"[3].

Thus, there is no uniformity in the field of teaching ESP - researchers note the predominance of communicative and competence approaches, and also note the growing popularity of the project method [4]. Such a lack of methodological uniformity forces practicing teachers to combine methods and approaches, adapting available materials to the needs of students of a particular specialty. The project method is the most common method of teaching ESP, which is confirmed by numerous studies[5] [6]. The growing popularity of the lexical approach in the field of teaching ESP is also noticeable[6]. In general, researchers note positively the effectiveness of the lexical approach[7] – it activates speech fluency, helps to reduce the time for replenishing vocabulary[8], allows for an increase in active and passive

[2] Polubichenko L. V., Kharlamenko I. V. Trends in the development of foreign language education in a non - linguistic university. *Lomonosov Pedagogical Education Journal*, 2021, no. 1, pp. 16-31. (In Russian) URL: https://elibrary.ru/item.asp?id=45644696 DOI: https://doi.org/10.51314/2073-2635-2021-1-16-31

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Eremina V. M. Using lexical approach in teaching English to the students of mining engineering majors. *Scholarly Notes of Transbaikal State University*, 2023, vol. 18 (2), pp. 145-154. (In Russian) URL: https://elibrary.ru/item.asp?id=53840558 DOI: https://doi.org/10.21209/2658-7114-2022-18-2-145-154

[7] Lyamova O. O. Lexical approach in teaching a foreign language at a medical university. *Problems of Modern Pedagogical Education*, 2024, no. 84 (1), pp. 171-174. (In Russian)

Atyaksheva D. A. The effectiveness of the lexical approach in teaching students of a higher educational institution (level a1-a2). *The World of Science, Culture, Education*, 2023, no. 2, pp. 172-175. (In Russian) URL: https://elibrary.ru/item.asp?id=53698591

[8] Lyamova O. O. Lexical approach in teaching a foreign language at a medical university. *Problems of Modern Pedagogical Education*, 2024, no. 84 (1), pp. 171-174. (In Russian)

vocabulary [9], and helps to quickly memorize specialized terminology and cope with it. In the study by V. M. Eremina, the survey method, the compilation of a "bank" of lexical units, memorization of vocabulary using Quizlet cards, the use of exercises for memorizing vocabulary, word formation, selection of definitions, etc. were noted[10].

Particularly indicative and informative for us was the study by N.V. Guskova [11], which examines the use of cognitive and lexical approaches using a project methodology for teaching students majoring in economics specialized vocabulary. This study differs from others in its experimental base (control and experimental groups of 23 and 22 people were studied, where the control group studied specialized vocabulary in the context of the traditional approach, and in teaching the experimental group, a synthesis of cognitive and lexical approaches was used, implemented in the use of the project method. The result of the study showed better assimilation of specialized vocabulary by the participants of the experimental group, better formation of skills in working with specialized texts, appropriate use of specific terms, constructions and concepts.

Given the existing gap in the development of methodological strategies tailored to ESP instruction, this study addresses a critical need for practical guidance relevant to practitioners in the field. The study compliments the research on detecting the effective teaching and assessing methods in the ESP field.

The novelty of this research resides in its investigation of the efficacy of integrating the lexical approach with project-based methods within the context of teaching English for Specific Purposes (ESP), as well as in its comparison with the conventional grammar-translation approach.

The hypothesis that guided this study was the following: if specialized vocabulary is taught through the use of lexical approach, namely focusing on specialized collocations used within a particular field, and project-based learning combining conventional language learning exercises with interactive pedagogical strategies, the students will show a better performance in the recognition and use of specialized vocabulary at the end of the course.

The aim of the research is to justify the efficacy of the integration of lexical approach and project-based learning as teaching methods for a successful acquisition of English specialized vocabulary by non-linguistic students.

Methods

In the current study, both the scientific theoretical method (analysis of linguistic sources) and empirical methods (testing method, project method, observation) were used.

The participants in this study were 60 third-year bachelor students of the Institute of Physics at the Kazan (Volga Region) Federal University. They were enrolled in a Bachelor's degree

[9] Galich T. S. On application of the lexical approach to teaching English for specific purposes. *Bulletin of Voronezh State Pedagogical University*, 2022, no. 3, pp. 193-198. (In Russian) URL: https://elibrary.ru/item.asp?id=49554734 DOI: https://doi.org/10.47438/2309-7078_2022_3_193

[10] Eremina V. M. Using lexical approach in teaching English to the students of mining engineering majors. *Scholarly Notes of Transbaikal State University*, 2023, vol. 18 (2), pp. 145-154. (In Russian) URL: https://elibrary.ru/item.asp?id=53840558 DOI: https://doi.org/10.21209/2658-7114-2022-18-2-145-154

[11] Guskova N. V. Cognitive and lexical approaches in the English language course for academic and special purposes using project-based learning (on the example of students of the faculty of economics) // Pedagogy and Psychology of Education, 2021, no. 4, pp. 68-83. (In Russian) URL: https://elibrary.ru/item.asp?id=47636104 DOI: https://doi.org/10.31862/2500-297X-2021-4-68-83

programme “Nanotechnology and Microsystem Technology” studying the course “Professional English” (36 academic hours) from September 2023 until December 2023.

The participants were divided into two groups both having B1-B2 English level: the control group (30 students, two study groups with 15 students per one teacher) and the treatment group (30 students, two study groups with 15 students per one teacher).

The study was conducted in two groups of students in the amount of 30 people in each, of which the students of the control group studied specialized vocabulary based on the traditional teaching method (grammar-translation method), and the students of the treatment group studied specialized vocabulary based on the lexical approach. At the end of the experiment, representatives of both groups presented their projects, the effectiveness of which was assessed on a scale of 10 parameters.

Data Collection Procedure

In order to achieve the purpose of the research, we implemented a mixed methods research design adopting both quantitative and qualitative methods.

Pre- and post-testing results let the authors reveal the quantitative dynamics of students’ specialized vocabulary knowledge, and the study projects (project summary presentation), in its turn, made it possible to compare grammar and specialized vocabulary proficiency in two groups.

Due to observation the authors could trace the students’ progress in vocabulary acquisition across the course.

The authors designed the assessment tools to measure the improvement of specialized vocabulary of the third-year students which included: a. original specialized vocabulary pre- and post-tests; b. 10-criteria evaluation scale for study projects (including 2 criteria denoting the level of oral proficiency, encompassing both grammar and specialized vocabulary).

All of the pre- and post-testing results were analyzed statistically using R-Studio (PBC, a public-benefit corporation, USA) and the results of the projects presentation were analysed using Origin 10.0 SR0 (OriginLab Corporation, USA).

After calculating the final scores of the test two English teachers compared the pre-test and post-test scores in their groups (two groups of 15 students in the control and treatment groups per one teacher, 30 students per teacher).

The mean pre- and post-test scores were calculated separately for the treatment and control groups using the results from the test.

Original specialized vocabulary tests were administered to the students in order to identify their ability to recognize and understand the meaning of the specialized terms in nanotechnology sphere; to translate these terms with reference to context over a period of time. The pre-and post-tests on specialized vocabulary included:

1. General overview of the subject (multiple choice tasks)
2. ESP collocations and definitions (matching tasks)

The pre- and post-tests on specialized vocabulary are presented in Table 1 and Table 2 below.

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Table 1

Specialized vocabulary pre-test

Таблица 1

Предварительный тест по специализированной лексике

A. Choose the correct answer, A, B or C.

1. What does the prefix “nano-” refer to in scientific terms?
   a) One million
   b) One billion
   c) One billionth
2. Which of the following best describes nanotechnology?
   a) The study of large structures
   b) The manipulation of matter on an atomic or molecular scalec) The use of traditional manufacturing methods
3. What is a common size range for nanomaterials?
   a) 1 to 100 micrometers
   b) 1 to 100 nanometers
   c) 1 to 100 centimeters
4. What is a nanosensor?
   a) A tiny device that detects changes in the environment
   b) A large device for measuring temperature
   c) A type of computer
5. What is the primary focus of nanotechnology research?
   a) Manipulating materials at the nanoscale
   b) Understanding large-scale phenomena
   c) Building traditional structures
6. Which of the following describes a nanocomposite?
   a) A material made from large particles
   b) A combination of nanoscale materials to enhance properties
   c) A type of computer chip

B. Match the words connected with nanotechnology to make up collocations:

1. Nanostructures	a) principles
2. Nanomaterials	b) self-assembly
3. Molecular	c) applications
4. Nanoparticles	d) properties
5. Mechanosynthesis	e) synthesis
6. Nanoscale	f) field
7. Nanoelectronics	g) behaviour

C. Match the collocations from ex. B to the definitions below:

1. The physical and chemical interactions and properties exhibited by particles in the nanometer range, which can differ significantly from those of bulk materials.
2. The process of creating structures at the nanometer scale (1 to 100 nanometers) by manipulating materials at the atomic or molecular level.
3. Unique characteristics or behaviors exhibited by materials at the nanoscale level, influenced by quantum effects, high surface area to volume ratio, and other phenomena.
4. A process by which molecules spontaneously organize into structured arrangements or patterns without external guidance, commonly observed in nature.
5. The various uses and implementations of materials that exhibit unique properties because of their nanoscale dimensions, found in fields such as medicine, electronics, and construction.

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Table 2.

Specialized vocabulary post-test

Таблица 2

Контрольный тест по специализированной лексике (после эксперимента)

A. Choose the correct noun that best fits the adjective provided. Select one option in each task.

1. high-_____ materials A) purity B) difficulty C) complexity
2. low-_____ voltage A) power B) concentration C) resistance
3. hot-_____ process A) pressing B) cooling C) freezing
4. size-_____ properties A) dependent B) independent C) similar
5. stress-_____ test A) strain B) gain C) weight
6. tough-_____ surface A) wearing B) making C) determining
7. machine-_____ ceramics A) hot-pressing B) cold-pressing C) warm-compressing
8. eco-_____ materials A) friendly B) heavy C) strange
9. energy-_____ technique A) wasteful B) efficient C) consuming
10. corrosive-_____ environment A) hazardous B) safe C) mild

B. Fill in the blanks with the correct collocation. Choose from

Cast a metal	Load-carrying capacity
Refine copper	Size-dependent
Synthesize new materials	Energy-efficiency
Extrude a plastic	Hot-pressing
Stress-strain curve	Core-shell

1. The researcher explained the _____ curve, showcasing the properties of the material.
2. Engineers often use _____ methods to enhance material strength.
3. The lab plans to _____ metals to create innovative components.
4. New experiments were conducted to measure the _____ of the new alloy.
5. They decided to _____ the polymer mixture to improve its properties.
6. The _____ nanoparticles exhibit unique behavior under certain conditions.
7. We need to _____ the testing process for better accuracy.
8. The team studied the _____ properties of the material under varying conditions.
9. Scientists are looking to _____ new composites with improved thermal resistance.
10. The lecture covered the _____ of the digital interface.

C. Fill in the blanks in the sentences with 1 word:

1. The scientist designed a new _____ material for the experiment.
2. The _____ performance of the system impressed the researchers.
3. To achieve the desired results, we need to _____ new materials carefully.
4. The carbon _____ of the process needs to be reduced.
5. The team presented a comprehensive report on _____ efficiency.
6. The single _____ silicon wafer is crucial for the devices.
7. They need to _____ data before finalizing the project.
8. The long-term _____ of the treatment are still unknown.
9. To achieve the best results, always follow the _____ outlined in the manual.

The new prototypes consist of _____ composite for better durability.

Student projects were used for assessing the efficacy of the gained specialized vocabulary. They were rated according to the following criteria from 1 to 5:

1. Understanding / setting / formulating the professional problem
2. Quality of research
3. Originality/ innovativeness
4. Team work
5. Practical applicability
6. Appropriateness of language/ grammatical correctness
7. Vocabulary usage: lexical richness; using specialized collocations in speaking
8. Work with sources
9. Scope of work
10. Quality of presentation

The project criteria for measuring language proficiency (a linguistic component of project assessment) were the following.

Criterion 6 of the student project 'Appropriateness of language/grammatical correctness' included the following indicators which were given the scores from 1 to 5.

5 scores

– using words and expressions that are suitable for a particular context;

– taking into account such factors as logic, coherence, formality;

– adhering to the rules of spelling, punctuation, and grammar.

4 scores

– using words and expressions that are suitable for a particular context;

– taking into account only logic and coherence;

– adhering to the rules of spelling and punctuation, having grammar errors.

3 scores

– using words and expressions that are not suitable for a particular context;

– considering only logic;

– having spelling, punctuation and grammar errors.

2 scores and below

– using words and expressions that are not suitable for a particular context;

– not considering logic, coherence, formality;

– having spelling, punctuation and grammar errors

Criterion 7 'Vocabulary usage: lexical richness; using specialized collocations in speaking' included the following indicators which were given the scores from 1 to 5.

5 scores

– using a variety of specialized collocations (noun-noun collocations, adjective-noun collocations, collocations of compound words, verb-noun collocations)

– not making mistakes with collocations, particularly when it comes to verb-noun and adjective-noun pairings;

– oral proficiency in spontaneous communication.

4 scores

– using mostly adjective-noun collocations and collocations of compound words in speaking;

– making some mistakes with collocations when it comes to verb-noun and adjective-noun pairings;

– a certain degree of oral proficiency in spontaneous communication.

3 scores

– using specialized collocations in speaking to a small degree;

– making many mistakes with collocations;

– not having oral proficiency in spontaneous communication.

2 scores and below

– not using specialized collocations in speaking;

– demonstrating a limited general vocabulary in speech.

– not having oral proficiency in spontaneous communication.

Teaching Methodology

We chose the lexical approach and project-based learning as the main approaches alongside with a grammar-translation method for the purpose of the present research.

A grammar-translation method (the 'Classical Method') is a grammar-based approach which is based on cognitive approach. This method has been widely applied to develop a strong understanding of grammar, to increases learners' reading comprehension. But this method can be regarded by the learners with different learning styles as unproductive and uninspiring due to the fact that it hinders students' motivation[12] [6].

In contrast to a grammar-translation method, lexical approach implies a rapid vocabulary acquisition, it has a practical orientation – students learn the vocabulary which is necessary for their professional activity. Lexical approach with its concentration on teaching fixed terms is commonly used by ESP teachers. The proponents of this approach hold the view that students become aware of the structure of the foreign language while recognising lexical chunks[13].

Teaching ESP English has benefitted from the use of formulaic language, with collocations and lexical chunks, in particular. N. Schmitt [7] considers the formulaic sequences to facilitate the mastering of the foreign language because "multi-word sequences are understood more quickly than non-formulaic words".

Due to the significant results of many empirical studies formulaic sequences are recognised as an effective tool serving for promoting better methods of teaching ESP.

The Lexical approach, founded by M. Lewis [14] in 1993 posits that language is composed of lexical units rather than grammatical ones. J. Sinclair[15] and M. Hoey[16] [8], contributed to its development, while others like K. Lackman[17], H. Dellar and A. Walkley [9] have further developed and implemented these principles in teaching EFL (English as a Foreign Language).

The Lexical approach is a learning method based on the following principles:

1) Grammar is grammaticalized lexis, where learners negotiate meaning through vocabulary rather than relying on grammatical rules. It is vocabulary, or more specifically, lexis, which learners need to negotiate meaning.

2) Words are not used alone, but rather in combination with other words. This principle was first proposed by John R. Firth and later developed by P. Davis and H. Kruzsewska in their book "The company words keep"[18].

The main concepts of the lexical approach are collocations and lexical chunks, which describe the way individual words cooccur with others. Collocations are formed when two or more words are often used together in a way that sounds

[12] Polubichenko L. V., Kharlamenko I. V. Trends in the development of foreign language education in a non-linguistic university. *Lomonosov Pedagogical Education Journal*, 2021, no. 1, pp. 16-31. (In Russian) URL: https://elibrary.ru/item.asp?id=45644696 DOI: https://doi.org/10.51314/2073-2635-2021-1-16-31

[13] Lackman K. Lexical Approach Activities. – 2011. URL: https://kenlackman.com/files/LexicalActivitiesBook102.pdf

[14] Lewis M. *The Lexical Approach*. London: Language Teaching Publications, 1993.

[15] Sinclair J. *Corpus, Concordance, Collocation*. Oxford: Oxford University Press, 1991.

[16] Hoey M. *Lexical Priming: A New Theory of Words and Language*. London: Routledge, 2005.

[17] Lackman K. Op. cit.

[18] Davis P., Kryszewska H. *The Company Words Keep*. Delta Publishing: Delta Teacher Development Series, 2013.

correct, such as verb + noun, adjective + noun, or verb + preposition. The concept of "lexical chunks" is broader, it includes not only collocations, but also phrasal verbs, idioms, sentence frames, social formulas, and discourse markers.

N. Schmitt states that lexical chunks "facilitate clear, relevant, and concise language use. Because of their functional usage, knowledge of lexical chunks is essential for pragmatic competence" [7].

3) This principle suggests that the English lexical unit is not equivalent to the native language, suggesting that word-for-word translation should be abandoned in foreign language lessons. At the same time, this principle does not imply a complete rejection of the use of the native language of students in the classroom. Instead, we are discussing the translation of collocations and phrases, not individual words. The provision is based on 1960s contrastive analysis achievements and contrastive linguistics work in teaching foreign languages, as highlighted by E. Puimège [10], S. Dewiyanti et al. [1], S. Sadoughvanini and H. Ghaemi [2].

4) Principle 4 encourages students to explore language use more than explain it, as language is an organism rather than a mechanism. This principle is based on research in corpus linguistics, focusing on "live" linguistic material, and is influenced by the works of Sinclair and Lewis.

5) Principle 5 highlights the importance of assessing pupils' mastery of individual words rather than collocations. According to Hoey's lexical priming theory, pupils should focus on common phrases from commonly used words when learning English [8].

The use of Lexical Approach for teaching ESP has been studied by a number of scholars [17; 18; 19] and its practical application has also been described thoroughly [15]. The results of the previous research have shown positive impact on enriching and activating students' vocabulary, as working with lexis is one of the key features of ESP [12; 13]. Both short-term and long-term memory functions are activated for memorization through repeated repetition and consolidation of the reading material.

As technical dictionaries do not encompass all relevant terms, educators in the engineering field should construct a specialized lexicon of engineering terminology to cater to the specific linguistic requirements of students pursuing engineering studies [14; 15; 16; 17; 18].

Some scholars convincingly suggest the predominance of communicative activities in the ESP classroom as specialized vocabulary should only be taught in a communicative context and not as isolated words; the necessity to focus on group work, to use authentic materials from the special field of study, to embed project-based types of assessment and to develop learners' oral presentation skills [19; 20]. Kondos[19] proposes to "incorporate lexical chunks via communicative pedagogy that introduces the taught collocations and lexical chunks via interactive communitive language material".

According to the lexical approach, in addition to employing lexical items in their own discourse, educators should encourage students to utilize collocations and lexical chunks in context. Students need to engage in input-based tasks, such

[19] Kondos S. *The Correlation Between Teaching Collocations and Lexical Bundles and the Improvement in the Writing Skill of First-Year University Students* (Publication No. 30610972 Doctoral dissertation, University of Exeter (United Kingdom)). ProQuest Dissertations & Theses Global, 2023. URL: https://www.proquest.com/openview/29e975929e3587a060210df9c7fb5f12/1?cbl=2026366&diss=y&pq-origsite=gscholar

as listening to or reading material and subsequently responding.

The lexical approach encompasses participation in information gap activities, writing exercises, speaking tasks, and role-playing simulations [4; 21; 22]. Discussions and simulations that create a more realistic environment have been demonstrated to be effective methods for engaging students in communicative tasks. An instructor can integrate the lexical approach with various methodologies, ranging from grammar translation to task-based learning and role-playing activities.

Some scholars claim that ESP learners primarily have lexical demands in a specific topic [23; 24]. This notion is supported by the findings of this study, which show that students were more interested in specialist language than academic discourse terms.

Project-based learning serves both a teaching and a control function.

Russian and foreign scholars denote that it is reasonable to incorporate both individual and group projects in student learning, as both types offer unique benefits[20] [25; 26].

In the classes of ESP individual projects allow for independent learning taking into account the language and speech needs of the student, enhancing student motivation and engagement in learning; and the development of critical thinking. Group projects foster communication, collaboration and teamwork.

In the present research, this method was used both for teaching and assessing purposes, that is for enhancing specialized vocabulary and evaluating the its level.

In order to design and present a project, students should possess a large volume of diverse specific subject knowledge, the ability to work with information, with text in English (highlight the main idea, search for the necessary information in the English-language text), analyze information, make generalizations, conclusions. Thus, in the process of learning students' intellectual, creative, and communicative skills are being developed.

Pedagogical Intervention

During the course, the main methods for teaching professionally oriented vocabulary were grammar-translation method in the control group; lexical approach and project-based learning in the treatment group.

In the treatment group, teaching was aimed at implementing reading, writing and speaking activities based on the lexical approach with the special accent on teaching collocations and lexical chunks. Students studied the terms specific to physics (nanotechnology in materials science in particular), and used them in writing and speaking.

In the treatment group, the lexical approach was used at several levels – from recognizing individual words and word forms to using them in collocations and sentences, with further progression to oral and written speech.

During the first stage (September-October 2023), exercises for working with lexical material included tasks to identify single vocabulary units as well as collocations and lexical chunks in context, guesses about the possible part of speech, guesses about the possible meaning of a lexical unit, and checking it with a dictionary.

Exercises on changing the word forms (*diffuse – diffusion – diffused – diffusible*, *corrode – corrosion – corrosive*, *adsorb – adsorption – adsorbent – adsorptive*) were followed by the study of the main productive ways of technical

[20] Abramova I. E., Shishmolina E. P. Individual and group projects in English at the university. *21 Century Teacher*, 2020, no. 2-1, pp. 74-84. (In Russian) URL: https://elibrary.ru/item.asp?id=43158087 DOI: https://doi.org/10.31862/2073-9613-2020-2-74-84

word building (*composition, nominalization and acronyms*). The latter included creating nominalised sentences by changing the verbs or adjectives to nouns: *activate (v) – activation (n), absorb (v) – absorption (n), circular (adj) – circle (n), corrosive (adj) – corrosion (n)*; learning the abbreviations connected with the names of some specific experimental processes using monolingual and bilingual dictionaries (*carbon nanotube – CNT, chemical vapor deposition – CVD, physical vapor deposition – PVD, thermal and cyclic steam stimulation – TSS; stream-assisted gravity drainage – SAGD; surface mechanical grinding treatment – SMGT*); translating compound words related to the materials processing, physical and chemical conditions and properties of materials (adjective – noun words: *low-voltage, high-strength, high-purity, high-ductility, hot-pressing, reduced-weight; cohesive-zone*; noun – adjective words: *heat-affected, net-shaped, load-carrying, node-release, size-dependent, center-notched, energy-efficient, element-based, load-applied, bulk-nanostructured, fiber-reinforced*; noun – noun words: *stress-strain, displacement-delamination, load-transfer, shape-memory, traction-separation, core-shell, liquid-phase, scale-removal*; and compound words related to the mixture of substances: *graphene-oxide, ceramic-polymer, polymer – only, boride-based, single-crystal, ceramic-metal*. After the stage of controlled practice exercises, students then made their own sentences with the learned words.

Examples of noun + noun, adjective + noun, or verb + noun collocations were presented to students so they could increase their knowledge of collocations and lexical chunks making up their own sentences:

a. noun plus noun: *scale-removal filter (methods, system), traction-separation test (cohesive element, model), stress-strain curve (graph, formula, diagram), liquid-phase extraction (oxidation of n-butane, epitaxy), core-shell nanoparticles (nanowires, quantum dots), high-ductility materials (steel, copper, aluminum, metal*.

b. adjective plus noun: *hot-pressing ceramics (machine), size-dependent properties, load-carrying capacity (equipment), load-applied force (formula), bulk-nanostructured materials); cohesive-zone modelling, plastic deformation*.

c. compound words related to the mixture of substances: *single-crystal diamond semiconductor (silicon, x-ray diffraction), ceramic-polymer composites (electrolyte, coating), graphene-oxide synthesis (structure, raman), polymer-only allocation method*.

d. verb + noun: *to filter particles (sediment), to extrude a plastic, to work-harden a metal, to cast a metal, to temper a metal, to synthesize new materials, to oxidize copper, to refine copper, to vulcanize rubber*.

The following tasks were assigned to the students: "*What other nouns can you use after the adjective 'load-carrying'*? e.g. *Lubricating oil storage was the main reason for the increase in load-carrying capacity*", "*What other nouns can you use after the noun 'traction-separation*'? e.g. *These traction-separation laws can be classified as bilinear*"; "*Make up sentences using these collocations and lexical chunks*" e.g. *When synthesizing new products ion exchange is a powerful technique for converting one material to another*".

Other assignments included matching the statements and rewriting them by using collocations, filling in the blanks with the appropriate collocations, completing the provided incomplete sentences, translating the texts containing collocations with the use of monolingual and bilingual collocation dictionaries, adding the appropriate collocations in the provided texts. The tasks described above

enhanced students' knowledge on other possible environments and uses of each collocation.

At the second stage (November 2023), the teachers initiated the review of the material of different disciplines learned by the students (Nanostructured Materials and Systems: Methods of Analysis and Control, Physical and Chemical Processes for Micro- and Nano-Technologies, Synthesis Methods of Nanostructures, Physical Methods for Nanocoating), namely the physical methods of nanoparticle production, the methods of diagnostics and analysis of nanosystems, control of nanotechnological processes, microsystem equipment and technologies; and manufacturing technologies for micro- and nano-processing. The analysis of different aspects of nanoparticles formation was made. Among the discussion topics were: "The development of protective and light-absorbing nanostructured coatings", "Nanostructures for medicine and pharmaceuticals", "Physics methods and information technologies in biomedicine", "Nanomaterials in fuel cells", "Nanostructured materials for food packaging applications", "Nanotechnology in cosmetics and clothing"; the physics students had an opportunity to read the article "The refined application and evolution of nanotechnology in enhancing radiosensitivity during radiotherapy" and to discuss it afterwards [27]. Then, the task to use specialized collocations in writing describing the experiment procedure was assigned to the learners. All the above-mentioned tasks were assessed by using detailed rating scales.

At the final stage (December 2023), the students prepared the project summary and presented it to the 'project sponsors'. They played the role of researchers applying for scientific research funding using the learned specialized vocabulary. The task was a. to define what the problem was; b. to state the aims of the research; c. to define the methods to be used and the procedures to be followed; d. to mention about the anticipated outcomes; e. to outline the limitations of the research.

The majority of the students were interested in the development of methods of nanostructures formation for medical applications. Group 1 presented the research project named "Self-assembly of nanostructures for medical applications". Group 2 was engaged in the research "Modelling of magnetic properties of rare earth fluoride nanoparticles for biomedical applications". Group 3 presented the research "Synthesis of silver nanoparticles via laser ablation in solution for biomedical applications". The summary of one project and collocations used by the students in their oral presentations are given in Table 3 below. After students' project presentations, the teachers provided feedback to students assigning the overall mark to the groups according to the criteria mentioned above, providing specific comments on individual oral proficiency on the criterion 6 and on the criterion 7.

Table 3

The students' project "Self-assembly of nanostructures for medical applications"

Таблица 3

Студенческий проект "Самосборка наноструктур для медицинских приложений"

Project 1 "Self-assembly of nanostructures for medical applications"

1. *Definition of the problem. A statement that explains why the research matters.*

In the modern world nanostructures and nanostructured materials are used for developing protective and light-absorbing coatings, medicines and medical equipment, fuel elements, food packaging materials and also for cosmetics and clothing manufacturing.

The possibility to start the process of the light-induced self-assembly of nanostructures of a specified form and composition is of great interest both for fundamental science and for a number of practical applications.

Self-assembly representing a bottom-up approach eliminates the need for expensive multiple processing steps and photolithographic tools, reducing manufacturing costs.

2. *The aim of the research*

The development of the method of controlled complex nanostructures (metal- and semiconductor-based) formation for medical applications.

3. Methods and procedures.

For nanostructures to be self-assembled into clusters it is necessary to apply quasi-resonance laser radiation which was modelled with the use of computer, namely with the use of such computational algorithms as dissipative particle dynamics, Monte Carlo methods, Molecular Brownian dynamics, and self-consistent field theory.

4. The expected outcomes of the research

The developed method of controlled complex nanostructures formation could allow to get ultra-small devices whose properties are defined in the process of growth.

5. Limitations of the research

Although the technique "Controlled or Directed Self-Assembly" addresses such challenges as minimizing defects and consistent uniformity, the achievement of industrial-grade quality still remains essential.

Collocations used in the oral presentation

"Bottom-up" approach, hydrogen bond, microphase separation, self-organisation processes, non-equilibrium conditions, self-assembly of atoms;

Light-induced self-assembly, controlled complex nanostructures, dissipative particle dynamics, self-assembled nanostructures; ordered supramolecular structures, nanomaterial shaping methods;

Quasi-resonance laser radiation, multi-choice component interactions, self-organisation processes, layer-by-layer assembly;

To fabricate nanostructures; to set properties, to heat from below, to cool from above.

Results

Let us define the main results of the present study.

We investigated the most relevant research works of Russian and foreign scholars describing the linguistic research in specialized English teaching.

We also explored the lexical approach, project-based learning and grammar-translation method as teaching methods for enhancing the students' specialized vocabulary and

substantiated the advantages of the first two ones over the last one.

We proposed the original pre- and post-tests and also study projects as evaluation methods for assessing the progress in specialized vocabulary acquisition.

Quantitative data collection took place at the beginning and at the end of the experiment. It was followed by the descriptive analysis.

In order to test the proposed hypothesis, the results of the specialized vocabulary tests and student projects, administered as part of assessment, were analysed using the statistical analysis.

Qualitative data were gathered through the observation of students' progress in vocabulary acquisition which took place during the course.

Integration and analysis of the quantitative and qualitative findings let the authors assume the implications for further teaching practice and future research.

Vocabulary Test Scores

To investigate the effect of teaching on students' performance, the change in scores for the test was calculated. Table 4, Table 5 and Figure 1 give a summary of the test scores on specialized vocabulary test in both groups.

Table 4

Pre- test and post-test results in the control and experimental group (Test scores on specialized terms test)

Таблица 4

Результаты теста по специализированной лексике в контрольной и экспериментальной группах до и после эксперимента

	Specialized terms			
Test scores	**Control group percentage of students (Total number: 30)**		**Treatment group percentage of students (Total number: 30)**	
	Pre-test	Post-test	Pre-test	Post-test
16-20	10 %	16,6 %	6,7 %	66,7%
11-15	47 %	53,3 %	40 %	23,3 %
6-10	33 %	23,3%	46,7 %	10 %
1-5	10 %	6.7 %	6,7 %	0 %
The mean value of the scores	10,8	12,03	10,33	15,53
The median value of the scores	11	12	10	16

Table 5

Comparative statistical indicators of the pre- test and post-test results of specialized vocabulary testing in the control and treatment group

Таблица 5

Сравнительные статистические показатели по результатам теста по специализированной лексике в контрольной и экспериментальной группах до и после эксперимента

Test scores	Control group (Total number: 30)		Treatment group (Total number: 30)	
	pre	post	pre	post
The mean value of the scores	10,8	12,03	10,33	15,53
The median value of the scores	11	12	10	16
The minimum value of the scores	4	5	4	7
The maximum value of the scores	17	19	19	20
2,5 % quantile	4	5	4,725	7,725
97,5 % quantile	17	18,275	18,275	20

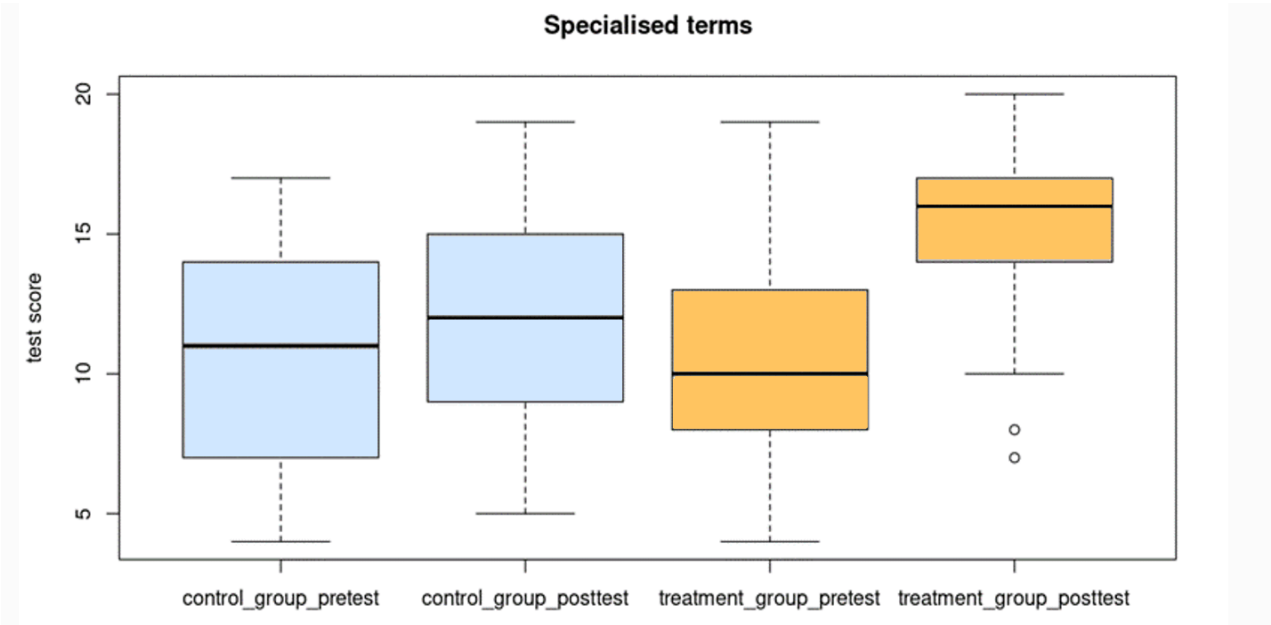

Fig. 1 Distribution of specialized vocabulary test scores achieved by students in the control and treatment group (pre-test and post-test)

Рис. 1 Распределение баллов, полученных студентами в контрольной и экспериментальной группах, за выполнение теста по специализированной лексике (до и после эксперимента)

There were no statistically significant differences between pre- and post-test results in the control and treatment group at the 95 % confidence interval (see Table 4, Table 5).

In the control group, there were no statistically significant differences between pre- and post-test results according to the Wilcoxon signed-rank test at the 95 % confidence interval.

In the treatment group, a statistically significant difference was found between pre- and post-test results according to the Wilcoxon signed-rank test at the 95 % confidence interval, with the post-test result being 1.6 times greater than the pre-test results (ratio of medians).

A statistically significant difference was also found between the post-test results of both groups at the 95% confidence interval, and the post-test result in the treatment group was 1.33 times higher than the post-test result in the control group (ratio of medians).

The Wilcoxon signed-rank test was used because the post-test data in the treatment group have a distribution that differs from normal one, therefore, the parametric tests for comparing means cannot be used. Normality was tested using the Shapiro-Wilk test.

The mean score in the treatment group increased by 53 per cent and the post-test score in this group was 42 per cent higher than the post-test score in the control group. In the control group, the dynamics was not significant: a gain in specialized vocabulary was only 11 per cent

Project Scores

Before choosing the method for comparing two groups, the data were checked for their compliance to the normal distribution using the normality test.

The difference between groups was statistically significant **P < 0,01, ***P < 0,01 Mann–Whitney U test. The boxplots in the Fig. 2 display the median (bold line), mean (×), and interquartile range (25th to 75th percentile) (Figure 2).

Since the distribution is not normal, the non-parametric Mann–Whitney U-test was used for comparison between two groups.

In comparison with the control group, a positive dynamic on the criterion 6 and on the criterion 7 was observed in the treatment group (Table 6 and Figure 2).

Table 6

Comparative statistical indicators of the control and treatment groups on the criterion 6: "Appropriateness of language / Grammatical correctness", Scores for Criterion 7: "Vocabulary usage: lexical richness; using specialized collocations in speaking"

Таблица 6

Сравнительные статистические показатели контрольной и экспериментальной групп по критерию 6 "Уместность языка/грамматическая правильность" и критерию 7 "Использование лексики: лексическая насыщенность, использование в устной речи терминологических словосочетаний"

Test scores	**Criterion 6**		**Criterion 7**	
	Control group	Treatment group	Control group	Treatment group
The mean value of the scores	3.77	4.60	2.93	4.37
The median value of the scores	4.00	5.00	3.00	4.00
The minimum value of the scores	2.00	3.00	2.00	3.00
The maximum value of the scores	5.00	5.00	4.00	5.00
2,5% quantile	3.00	4.00	2.00	4.00
97,5% quantile	5.00	5.00	4.00	5.00

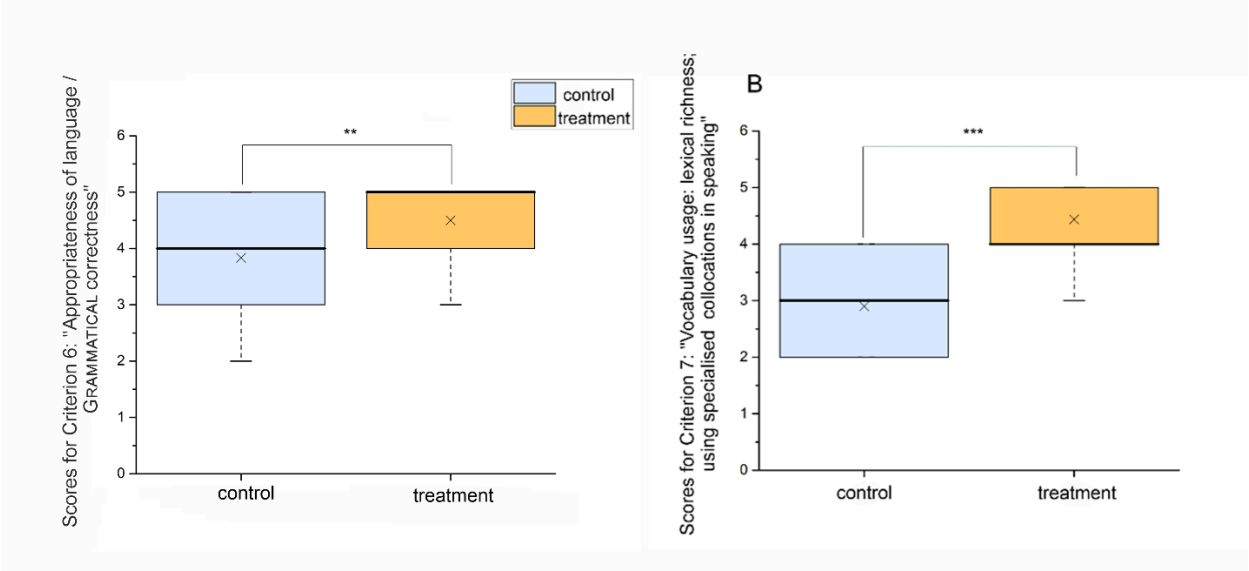

Fig. 2 Scores for Criterion 6: "Appropriateness of language / Grammatical correctness" (A), Scores for Criterion 7: "Vocabulary usage: lexical richness; using specialized collocations in speaking" (B) in the control and treatment groups.

Рис. 2 Баллы, полученные студентами контрольной и экспериментальной групп по критерию 6 "Уместность языка/грамматическая правильность" (А) и критерию 7 "Использование лексики: лексическая насыщенность, использование в устной речи терминологических словосочетаний" (В).

The projects assessment also revealed that the scores on the criterion 6 were by 22.02 percent higher and the scores on the criterion 7 were by 49.15 percent higher in the control group.

After the intervention which resulted in the presentation of the project summaries, students' knowledge of specialized vocabulary increased in the treatment group which was evident in a larger number of correct responses to the test assignments and oral fluency during the projects presentation.

The observation revealed that the students of both groups could discuss nanotechnologies in the material science, describe the experiment procedure in writing and present the project summary with the use of specialized collocations, but with certain differences.

In comparison with the control group, the students in the treatment group used words and expressions that were suitable for a particular context fully adhering to the logic, coherence and to the rules of spelling, punctuation, and grammar.

They used specialized collocations in complex sentences in the proper context in their written speech and in speaking making few mistakes, and demonstrated an oral proficiency in spontaneous communication. The observation of students in the control group did not reveal the same things.

The present study was motivated by a need to understand what activities that provide effective vocabulary acquisition should be implemented in teaching and what assessment methods should be used.

In reference to the proposed hypothesis, our results are consistent with the outcomes of the

study of N.V. Guskova[21] showing the efficacy of lexical approach and project-based learning for a better vocabulary acquisition.

The present findings support the view of M. Orang et al. [28] that matching the statements and rewriting them by using collocations, filling in the blanks with the appropriate collocations, completing the provided incomplete sentences, making sentences with the given collocations, adding the appropriate collocations in the provided texts, describing an experiment procedure contribute to a better awareness of the material under study, and to a better acquisition of the language material.

The findings also complement the study of F. Khonamri and S. Roostaee [4] who state that extensive reading, repetition, practice and interactive learning which implies discussion and group projects with oral presentation to the class are essential for helping students learn collocations.

As D. Rus [19] claims, it is essential to incorporate the taught collocations and lexical chunks into written and oral speech – the results of the present study indicate that specialized terms appeared to be best acquired both through spoken and written communication.

However, much research is still needed to resolve many important issues. The challenges of developing materials for teaching ESP vocabulary to students of all English levels and tests to examine the knowledge of collocations arise. Ways of assessing students' specialized vocabulary knowledge and their progress need to be reconsidered because the depth of lexis awareness can't be measured in one single test.

Implications for further research could be the use of contrastive analysis to teach collocations. Collocation mastery and speaking fluency could be further improved by combining traditional language learning approaches, memory-enhancement strategies and communication approach.

The subject of further research could be developing writing and speaking skills of students with the use of more complex sentences with multiple clauses, with the use of learned collocations and finding out the ways of their assessment.

Conclusions

The present study compliments the research on detecting the effective teaching and assessing methods in the ESP field.

In our view, the lexical approach with its focus on the systematic study of vocabulary and project-based learning represent the most suitable framework for ESP instruction, a hypothesis empirically validated through comparative analysis of the results in two student groups.

The present study adds to the evidence in the field of teaching ESP that a combination of conventional language learning exercises with interactive pedagogical strategies can affect EFL learners' collocation mastery and speaking performance.

The practical relevance of this study consists of reviewing its results for the development of teaching materials and knowledge assessment methods in the field of teaching English for Special Purposes in the field of physics and related specialties for academic groups with different levels of English proficiency.

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Elina Irkovna Murtazina

Contribution of the co-author: initiating the research, designing the concept of the research; reviewing the literature; formulating the hypotheses and the purpose of the research; selecting research methods and methodological approaches; formulating the learning content; conducting the experiment; collecting and analysing the data; drawing conclusions; preparing the final version of the paper.

All authors reviewed the results of the work and approved the final version of the manuscript.

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Научная статья / Research Full Article
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Интеграция лексического подхода и метода проектов для успешного освоения специализированной лексики на английском языке студентами неязыковых специальностей

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Проблема и цель. *В статье рассматривается проблема методологических подходов в области преподавания специализированного английского языка. Цель исследования состоит в обосновании эффективности интеграции лексического подхода и метода проектов для успешного освоения специализированной лексики на английском языке студентами неязыковых специальностей.*

Методология. *Исследование основано на теоретическом анализе лингвистических источников по преподаванию специализированного английского языка и таких эмпирических методах, как тестирование, учебные проекты и наблюдение. Гипотеза была проверена с помощью статистического анализа результатов тестирования и учебных проектов. Методика преподавания включала грамматико-переводной метод в контрольной группе, лексический подход и проектное обучение в экспериментальной группе.*

Результаты. *Изучены и проанализированы актуальные исследования по указанной проблеме, проведенные российскими и зарубежными учеными. Обоснованы преимущества лексического подхода и метода проектов над грамматико-переводным методом в формировании специализированной лексики, что легло в основу сравнительного анализа. Авторы предложили оригинальные предварительный и итоговый тесты, а также учебные проекты в качестве инструментов оценивания эффективности усвоения специализированной лексики. Результаты тестирования и презентация студенческих проектов показали, что в экспериментальной группе наблюдался прирост в знании специализированной лексики, в то время как в контрольной группе динамика была менее значительной. Наблюдение выявило, что студенты экспериментальной группы демонстрировали хорошее владение терминологическими словосочетаниями, применяя их в соответствующем контексте как в письменной, так и в устной речи, показывая беглость речи в спонтанном общении.*

Заключение. *В заключении сделаны выводы о том, что целесообразно сочетать традиционные методы обучения, направленные на освоение специализированной лексики, в частности терминологических словосочетаний, с интерактивными видами деятельности для повышения эффективности образовательного процесса.*

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***Ключевые слова**: лексический подход; проектное обучение; студенты неязыковых специальностей; специализированный английский; грамматико-переводной метод; терминологические словосочетания; устная грамотность.*

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