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THE APPLICATION OF TASK-BASED LEARNING AND DIGITAL TECHNOLOGIES IN ENGLISH LANGUAGE TEACHING FOR HIGHER EDUCATION STUDENTS

The authors of the article attempt at analyzing the effectiveness of Task-Based Learning (TBL) methodology in teaching English as a foreign language to students of applied mathematics specialty with the use of digital technologies. The relevance of the study is determined by the need to transform traditional approaches to foreign language teaching in higher education institutions, which often prove ineffective in developing practical communicative competencies for future specialists.

The study aims to verify the effectiveness of TBL methodology with student-generated content elements by means of using digital technologies for students majoring in Applied Mathematics. The research was conducted in the form of an experimental study. It included 19 third-year students as the participants of the study, which was conducted during the spring semester of 2025.

The research methodology included dividing students into working groups, who were assigned to create their own interactive lexical modules using various digital platforms and instruments. The study combined quantitative methods involving entrance and exit testing of professional terminology proficiency levels and qualitative methods including a Likert scale questionnaire used to assess student motivation, engagement, and confidence.

The results of the carried-out experiment demonstrate an increase in the students' academic achievement level. The percentage of students who obtained excellent grades at the end of the study rose from 10.5% to 47.3%. Moreover, by the final stage, there were no students who obtained grades D and E. The mean subjective assessment of the effectiveness of the used methodology was $M=4.84$ according to a five-point scale with a low coefficient of variation of 7.6%, which indicates a unanimous opinion among the respondents. Thus, the authors of the article draw the conclusion that using TBL and digital technologies in the format of student project creation is an effective strategy for teaching English to students with a physics-mathematics profile, as it corresponds well to their cognitive style and professional expectations.

Key words: *task-based learning, digital technologies, applied mathematics, student-generated content.*

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ЗАСТОСУВАННЯ МЕТОДИКИ TASK-BASED LEARNING ТА ЦИФРОВИХ ТЕХНОЛОГІЙ У ВИКЛАДАННІ АНГЛІЙСЬКОЇ МОВИ СТУДЕНТАМ ЗАКЛАДІВ ВИЩОЇ ОСВІТИ

У поданій статті здійснено аналіз ефективності впровадження методики навчання на основі виконання завдань (Task-Based Learning, або TBL) у процес викладання англійської мови як іноземної для здобувачів вищої

освіти технічного профілю, зокрема за спеціальністю «Прикладна математика», з активним залученням сучасних цифрових технологій. Актуальність представленого дослідження зумовлена потребою трансформації традиційних підходів до іншомовної підготовки у закладах вищої освіти.

Метою наукової роботи є експериментальна перевірка ефективності застосування методики TBL, збагаченої елементами контенту, створеного самими студентами, шляхом використання різноманітних цифрових інструментів. Дослідження носило емпіричний характер і проводилося протягом весняного семестру 2025 року. Експериментальною базою виступила група з 19 студентів третього курсу.

Методологія дослідження передбачала поділ студентів на малі робочі групи, завданням яких була розробка власних інтерактивних лексичних модулів із використанням цифрових платформ та онлайн-інструментів. Такий підхід дозволив змістити акцент з пасивного споживання інформації на її активне створення та опрацювання. Комплекс методів дослідження поєднав кількісний аналіз, який включав вхідне та вихідне тестування для визначення рівня володіння фаховою термінологією, та якісні методи, зокрема анкетування за шкалою Лайкерта, що було спрямоване на оцінку психолого-педагогічних аспектів: рівня студентської мотивації, залученості в навчальний процес та впевненості у власних мовних можливостях.

Аналіз отриманих даних дозволяє стверджувати про статистично значуще зростання рівнів академічних досягнень здобувачів освіти. Частка студентів, які отримали відмінні оцінки на завершальному етапі дослідження, зростає з 10,5% до 47,3%. Більше того, у фінальному зрізі знань були повністю відсутні студенти з низькими результатами (оцінки рівнів D та E), що свідчить про загальне вирівнювання успішності групи. Середня суб'єктивна оцінка ефективності запропонованої методики учасниками експерименту склала $M=4,84$ за п'ятибальною шкалою. При цьому зафіксовано низький коефіцієнт варіації (7,6%), що вказує на високий рівень однотайності респондентів у позитивному сприйнятті нововведень.

На підставі отриманих результатів автори доходять висновку, що синергія методики Task-Based Learning та цифрових технологій у форматі створення студентських проєктів є ефективною стратегією викладання англійської мови для студентів фізико-математичного профілю. Доведено, що такий підхід узгоджується з їхнім когнітивним стилем мислення, орієнтованим на вирішення проблем, та відповідає професійним очікуванням майбутніх фахівців прикладної математики.

Ключові слова: Task-Based Learning (TBL), навчання на основі завдань, цифрові технології, прикладна математика, студентський контент.

Problem statement. The current foreign language teaching in higher education is undergoing a significant change. Such classical linear approaches as the Presentation-Practice-Production (PPP) methodology have been an important aspect of the pedagogical models used in universities for decades. Although this method was useful in the past when learning a language was mainly seen as an academic exercise in translation and memorization, nowadays, as practice shows, it is becoming less and less useful (Richards, Rodgers, 2014: 34). This viewpoint is especially apparent when the goal of education is to produce highly skilled professionals who can use a foreign language as a practical tool for handling their real-world professional tasks and not as a mere subject of study.

Moreover, researchers argue that the natural, cognitive processes of language acquisition are frequently overlooked in traditional instruction. Conventional approaches cause significant discrepancy between the knowledge learned in the university auditorium and the requirements of professional communication in the real world since they place an undue emphasis on form (grammar rules, isolated vocabulary lists, and syntactic structures), instead of important content. Students frequently complain that although they have a theoretical understanding of the language structure, they are still unable to use it fluently in unpredictable professional speaking situations. For students in technical fields, where accuracy in communication is

essential, this gap becomes particularly problematic because discipline-specific communicative needs are rarely addressed in language instruction.

Consequently, there exists an urgent need to implement Task-Based Learning (TBL), an approach that fundamentally reconceptualizes language learning as a creative process of social interaction and cognitive construction. In contrast to outdated approaches in which the student is reduced to the role of a passive consumer of a pre-packaged “linguistic product”, TBL suggests an active approach in which language is implicitly learned through the performance of practical, goal-oriented tasks (Lai, Li, 2011: 499). This pedagogical change is especially relevant when it is applied to the needs of students majoring in technical specialties, particularly Applied Mathematics. The cognitive styles of these students are characterized by a tendency for logical reasoning, systemic analysis, tangible results, intelligible algorithms, etc. In order to turn the English classroom into a simulation of professional activity, the pedagogical challenge has to adapt the abstract principles of TBL to the particular context of technical specialties, where tasks must be grounded in authentic texts and professional contexts.

Analysis of previous research. Although there are many different ways to define a “task” in scientific discourse, scholars usually agree that it is a type of activity that is strictly focused on achieving a concrete outcome. One of the most important researchers in

TBL, R. Ellis, describes a task as a work plan that primarily requires meaningful language use, where learners focus on meaning rather than linguistic form. His groundbreaking work, which explores the connection between research, instruction, and tasks in ways that continue to influence modern pedagogy, has become a foundational study in this sphere (Ellis, 2003: 16).

David Nunan considers a task to be essentially different from an exercise because a task is more concerned with the result, whereas an exercise is more concerned with linguistic correctness. According to the author, tasks are activities that require students to understand, manipulate, produce, or engage in the target language while paying more attention to meaning than form (Nunan, 2004: 4).

J. Willis and her framework for TBL have become a classic reference for teachers in their practical implementation of the methodology. She outlines a three-stage structure consisting of pre-task, task cycle, and language focus, which has influenced classroom applications (Willis, 1996: 52).

C. Lambert, S. Aubrey and G. Bui added to this understanding by pointing out the non-linguistic objective of the task, which is to successfully complete a real-world task using language skills. Their view of TBL is consistent with the psycholinguistic theory, which explains that tasks promote critical cognitive functions like meaning negotiation, information processing, and cooperative interaction, all of which are important for language development (Lambert, Aubrey, Bui, 2023:7).

M. East's research demonstrated that tasks can guide learners' attention towards fluency, accuracy, and complexity through carefully designed tasks that are informed by code complexity, cognitive complexity, and communicative stress. The triadic model has proven useful in task design that takes into consideration learners' developmental stages and the communicative demands of language use. His study has demonstrated that tasks are qualitatively different and that the selection of tasks should be informed by an awareness of the interplay between task features and learner characteristics (East, 2021: 43).

Recent systematic reviews have demonstrated the effectiveness of task-based learning (TBL) on the development of communicative competence. The analysis conducted by Bryfonski and McKay showed that task-based learning is effective for developing oral proficiency when compared to other approaches (Bryfonski, McKay, 2019: 615). Furthermore, the inclusion of technology in task-based learning has been a natural progression of the methodology and has been informed by the communicative realities of the twenty-first century. In addition, M. González-Lloret

and L. Ortega argue that technology is more than just an adjunct to TBL, it can transform the very basis of tasks (González-Lloret, Ortega, 2014: 5).

Koos van den Branden's work on task-based language instruction emphasizes how important it is to close the gap between theory and practice. His research indicates that contextual factors must be taken into account for TBL to be implemented effectively. In the context of technical education, this includes the fact that students frequently doubt the benefits of learning a language, viewing it as incidental to their primary fields of study, which are engineering, math, and computer science (Branden, 2006: 10).

The **aim** of this research is to verify the effectiveness of Task-Based Learning methodology using digital technologies in teaching English to students majoring in Applied Mathematics.

Methods and research methodology. Taking into account the specific cognitive style of future specialists in the field of Applied Mathematics, which is characterized by a tendency for algorithmization, logical structuring, and systems analysis, the strategy of Task-Based Learning using digital tools was selected. The experimental basis for this study included an academic group of third-year students majoring in Applied Mathematics, consisting of nineteen respondents. The period of the experiment covered the spring semester of 2025, specifically from March to May, which provided sufficient duration for full implementation of the project methodology.

We put forward the hypothesis of the research that transforming the student from an object of teaching into a subject of student-generated content eliminates the barrier of alienation that technical students often feel toward the study of humanities disciplines. Instead of passive processing of standard textbooks such as "Professional English in Use", respondents were offered a complex and professionally-oriented task. They were assigned to develop their own interactive lexical modules that meet the modern requirements of linguodidactics. At first, the students were divided into small working groups, simulating the real conditions of work in the IT sector, specifically mimicking Scrum teams. Each participant performed a specific role, which ranged from content creator to product tester.

The researchers developed the diagnostic toolkit to measure objective indicators such as the success of vocabulary acquisition, and subjective psycho-pedagogical parameters, including motivation, engagement, and confidence. To achieve this objective, we employed a combination approach of testing entry and exit proficiency in professional terminology, as well as a lengthy questionnaire on a Likert scale. The

entry test, which was administered in early March 2025, consisted of forty multiple-choice questions. The questions focused on terminology in important fields such as algorithms, data structures, computational techniques, and mathematical modeling. In each question, a term or concept was presented with four potential definitions or applications, and the student was required to select the correct option. The test was designed to determine the students' familiarity with the technical vocabulary of English required for effective academic and professional discourse in applied mathematics.

Presentation of the main material. The process of training took the form of a single tech process, which consists of three stages. These stages are the preparatory-analytical stage, the constructive-creative stage, and the presentation-reflexive stage. During the first stage, which lasted throughout March, the students engaged in the analysis of the lexical set provided in standard professional materials. The task was not simply a matter of selecting the word, they also have to verify the word using corpus tools like Sketch Engine. They had to approach this as a database work problem, checking the frequency of the word, identifying collocations, and making semantic connections. This stage really tested their critical thinking skills, as they have to filter out outdated words and focus on those which are relevant in the current industry.

Students worked in groups of three to four members, each group assigned specific thematic areas such as “Types of computer systems”, “Input devices”, “Word processing”, etc. They were required to compile a glossary of at least fifty terms per group, including definitions, example sentences, and usage contexts. The result of this stage was the creation of structured glossaries in cloud-based spreadsheets, which served as the initial material for further work. It should be noted that the students demonstrated initiative in cross-referencing multiple sources. They compared explanations from academic textbooks, online resources, and corpus data to ensure accuracy and currency.

The second stage, which took place in April, was dedicated to the development of digital units. It proved to be the most complex and productive part of the experiment. The participants made use of various digital platforms such as Quizlet, LearningApps, Canva, etc. and transformed text data into interactive formats. Particular attention was paid to the gamification of the learning process. The development of exercises such as matching, fill-in-the-blanks, crosswords, and quizzes required students to understand the context of its usage in addition to the translation of a certain word. For instance, when creating a matching exercise for the lexeme “wearable”, the students had to generate

not only a correct definition but also plausible distractors – incorrect options that might seem correct to someone with partial understanding. This required them to anticipate common misconceptions and think metacognitively about the learning process itself.

An important aspect was that the groups functioned in a collaborative manner as they constantly shared ideas and worked through the draft work. The role of the teacher in this phase was a facilitator and a consultant. She intervened only when the students made methodological errors. This approach ensured that the participants had a good sense of autonomy regarding their final product. The practice of stand-up meetings, borrowed from agile development methodologies, was applied for each group to share their progress and receive feedback. This iterative process manifested continuous improvements and fostered a culture of continuous discussion in groups. The instructor observed how freely the students offered their feedback to each other, commenting on unsuccessful instructions, confusing layouts, or simplistic exercises, and realized that they had understood the professional standards.

The final stage in May involved testing and the defense of projects. It was performed as a process of peer teaching, where one group performed the tasks developed by another. This approach created a learning situation where students critically evaluated the work of their peers, searched for logical and linguistic “bugs”, and provided feedback regarding interface usability and clarity of instructions. It allowed the realization of the principle of “learning by teaching”, since to create a high-quality test or explain a rule, a student must first master it at an expert level. During the testing phase, students documented errors, ambiguities, and technical glitches they encountered, compiling bug reports that the creating group then used to refine their modules. This debugging process reminded the real-world software development practices, which reinforced the professional relevance of the task.

The final defense sessions were structured as formal presentations where each group demonstrated their module, explaining their design rationale, and responding to questions from peers and the teacher. Groups were evaluated not only on the quality of the final product but also on their ability to understand and integrate the pedagogical principles underlying their design choices.

To determine the students' attitude toward the new format of work, the researchers used a questionnaire with a 5-point Likert scale, where 1 point corresponded to the statement “strongly disagree” and 5 points to “strongly agree”. The obtained results demonstrate a high level of acceptance of the methodology by the target audience and confirm the effective-

tiveness of integrating digital technologies into the process of professional training. Detailed distribution of responses by key indicators is presented in Table 1.

The data in Table 1 reveal the highest mean value (M=4.84) for the item regarding the comparative effectiveness of the methodology. This figure serves as an indicator that applied mathematics students consider traditional reproductive teaching methods as outdated and ineffective. Productive activity involving content creation refers to their professional expectations and future career realities. The low coefficient of variation (7.6%) in this item indicates the unanimity of the group on this viewpoint regardless of their level of prior preparation. It suggests their preference for active learning process.

The indicator of M=4.78 for the item regarding the memorization of terminology confirms a psycholinguistic regularity since the information that has passed through the stage of active processing and structuring, known as deep encoding, is stored in long-term memory significantly better than information obtained through passive perception. After the experiment, the students noted that the process of selecting distractors (the incorrect options in multiple-choice tests) forced them to analyze the shades of meaning of words, which made mechanical learning impossible.

We observe a slightly lower indicator (M=4.42) regarding communicative skills. It can be explained by

the introverted personality type inherent in many representatives of the Applied Mathematics specialty. However, it was necessary to coordinate the structure of the unit and distribute duties in the team in order to make it a stimulus for the development of soft skills. Observation of the groups' work revealed an interesting gender aspect. In mixed groups, female students often worked as moderators and content editors, while male students focused on the technical implementation and logic of task construction. We have to note that this division of tasks was not imposed, it emerged organically since the students themselves chose their preferred roles that matched their strengths and interests.

Comparing the results of the entrance testing in March 2025 and the final control in May 2025 allows us to observe a qualitative change in the level of material mastery. We administered the exit test in late May 2025, which was structurally similar to the entrance test but featured different items to prevent the memorization of correct answers. It covered the same content areas and maintained equivalent difficulty levels. Data on the change on academic success are presented in Table 2.

The data in Table 2 demonstrate the complete elimination of the segment of low academic performance, specifically grades D and E, at the final stage of the experiment. At the beginning of the semester, 26.3% of students demonstrated a mediocre level of knowledge. However, after the implementation of the TBL

Table 1

Indicators of Subjective Assessment of TBL Methodology Effectiveness by Students (n=19)

Assessment Criterion (Questionnaire Statement)	Arithmetic Mean (M)	Standard Deviation (SD)	Coefficient of Variation (CV, %)
1. Creating my own exercises contributed to a deeper understanding and memorization of terminology.	4.78	0.42	8.7%
2. Using digital platforms increased interest in completing tasks.	4.63	0.59	12.7%
3. The group project work format improved communication and collaboration skills.	4.42	0.68	15.3%
4. I feel more confident in using professional English after the experiment.	4.73	0.45	9.5%
5. The Student-Generated Content methodology is more effective compared to traditional methods.	4.84	0.37	7.6%
6. The task allowed applying analytical skills (systems approach) in language learning.	4.57	0.60	13.1%

Table 2

Comparative Characteristics of Student Success on the ECTS Scale (n=19)

Grade on ECTS Scale	Entrance Control (Number of students / %)	Exit Control (Number of students / %)	Absolute Growth/Decline
A (Excellent)	2 (10.5%)	9 (47.4%)	+7 persons
B (Very Good)	5 (26.3%)	7 (36.8%)	+2 persons
C (Good)	7 (36.8%)	3 (15.8%)	-4 persons
D (Satisfactory)	3 (15.8%)	0 (0%)	-3 persons
E (Sufficient)	2 (10.5%)	0 (0%)	-2 persons

methodology, all students achieved a grade no lower than “Good” (C). We should note that the most indicative is the growth in the number of excellent grades, rising from 10.5% to 47.3%. This phenomenon can be explained by a change in the locus of control since the students felt personal responsibility for the quality of the created product because they knew that their developments would be used by their groupmates.

This “audience effect” worked as an external motivator, which fostered the students’ need to master the material perfectly in order to avoid making a public error. The fear of peer judgment, usually a source of anxiety in the classroom, was channeled into productive preparation and quality control. Students reported that they reviewed their modules several times before submission and it was not because of instructor requirements but because of concern for their reputation among peers.

The themes that emerged from qualitative feedback gathered in after-experiment discussions included the authenticity of the task, which students found more like real-world work than the typical classroom exercises. The opportunity to use the skills they have developed in math and programming classes and apply them to language learning was also appreciated. Some students reported that they had never considered language as a system that could be analyzed and optimized before, and the learning module development activity allowed them to recognize connections between linguistic and mathematical systems, which brought their technical identity closer to the subject matter in the humanities.

Conclusions. The results obtained in the study provide the grounds to assert that the integration of Task-Based Learning and digital technologies in the format of creating student projects is a highly effective strategy for teaching English to students of a physics and mathematics profile. The research revealed that the key factor of success was the congruence of the proposed methodology with the thinking style of the respondents. Applied mathematics students perceive language not as an abstract humanitarian system, but as a structured code that is subject to analysis and algorithmization. The task of developing a learning unit allowed them to apply their habitual mental operations (classification, modeling, and optimization) to linguistic material, which made language learning feel more relevant to their disciplinary sphere.

Another pedagogical conclusion is the rethinking of the role of digital technologies. In this experiment,

they acted not as “crutches” for translation or simplification of learning but as a means for creativity and professional self-realization. The students used a range of tools, which can be employed by them in further professional activity, whether in creating training materials for colleagues or in developing educational software. The application of these skills enhances the perceived value of the learning experience and shows that language learning can contribute to professional development beyond linguistic competence.

Furthermore, the methodology revealed a positive influence on group interaction. It promoted the integration of students and the development of teamwork skills, which is important for future IT specialists and data scientists who will work in collaborative spheres.

The structured group work during the experiment required the students’ negotiation, division of tasks, conflict resolution, and consensus-building, all of which are essential soft skills in technical professions. The participants of the study learned to give and receive constructive criticism, to articulate their ideas clearly to peers, and to coordinate complex projects with multiple moving parts. All these experiences will serve them well in their future careers.

Several perspectives for further research emerge. First, scaling this experiment to other technical specialties, such as computer science, engineering, or physics, will test the generalizability of the findings and allow to compare the usage of this methodology in other disciplines. Second, studying the long-term effect, or retention rate, by checking residual knowledge six to twelve months after the completion of the course will provide additional data on the durability of learning gains.

Third, of significant interest is a deeper analysis of the use of artificial intelligence tools in the process of content creation. As AI-powered language tools become increasingly advanced and sophisticated, there is potential to integrate them into TBL methodology. It can be done by encouraging students to use AI to generate initial drafts of exercises that they then refine and validate. This will develop critical skills in evaluating and editing AI-generated content, an increasingly important competence in the age of large language models.

The results of the conducted research prove that the transition from reproductive methods to productive ones, where the student is the author and creator, significantly changes the quality of foreign language teaching in establishments of higher education.

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