# An Innovative Model for Learning Ukrainian Terminology by International Students through the Use of Information and Communication Technologies

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*Abstract:* - This study proposes and experimentally validates a multi-level ICT-supported model for teaching Ukrainian scientific and technical terminology to international students. The study makes four principal contributions: developing a structured model for the gradual acquisition of professional terminology; introducing a formalised quantitative assessment system based on integrated learning indicators; applying statistical methods for the quantitative validation of the proposed model; and proposing a synergistic effect indicator for evaluating the combined effects of instructional components. The study involved 100 first-year international students from Vinnytsia National Technical University. The results were analysed using Student's t-test, Cohen's d, confidence intervals, coefficients of variation, the Shapiro–Wilk test, and polynomial approximation of learning dynamics. The findings demonstrated statistically significant improvements in terminology acquisition, lexical accuracy, communicative competence, and academic performance compared with traditional instruction. The framework provides an objective methodology for evaluating ICT-assisted terminology learning and may be applied in professional language courses in higher education.

*Key-Words:* - information and communication technologies (ICT), Ukrainian as a foreign language (UFL), terminological vocabulary, international students, innovative teaching model, linguodidactic methodology.

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## 1 Introduction

Higher education and scientific research play a crucial role in the international integration and development of Ukraine's educational system. Today, Ukraine has new priorities and requirements for the training of future specialists, a renewal of the educational system, and modernisation of the information technology base of the higher education process. A particularly important area of integration of the national education system into the international educational space is the education of international students in Ukrainian higher education institutions. The development of professional terminology competence is particularly important for international students studying engineering and technical disciplines, as it enables them to participate effectively in scientific communication, laboratory work, and academic collaboration within the technical university environment.

These challenges require the continuous improvement of the educational system, the

integration of modern information and communication technologies (ICT), and the enhancement of teaching methodologies that facilitate knowledge acquisition, increase learning motivation, and improve the professional training of international students.

One of the key objectives of contemporary education is to modernise teaching content, methods, and instructional tools through the widespread integration of information and communication technologies. In the context of educating international students in Ukraine, the effective use of ICT has become a strategic priority, as it enhances the quality, accessibility, and efficiency of the educational process while facilitating students' adaptation to the modern information environment.

The aim of this study is to improve the process of step-by-step acquisition of Ukrainian scientific and technical terminology through the use of information and communication technologies (ICT) in Ukrainian as a foreign language classes at Vinnytsia National Technical University (VNTU). The study also proposes an innovative instructional model supported by a system of ICT-based tasks and exercises designed for learning, consolidating, revising, and assessing terminology knowledge, as well as for developing international students' linguistic and communicative competences in professional communication.

The study is based on the hypothesis that the integration of ICT at all stages of terminology instruction in Ukrainian as a foreign language classes significantly enhances learning effectiveness.

The subject of the research is a systematic approach to teaching professional terminology to international students through blended learning supported by ICT tools, including online communication platforms, computer presentations, electronic dictionaries, and digital libraries.

## 2 Literature Review

Contemporary linguodidactic research has produced a wide range of approaches and methods for teaching foreign languages. Different researchers offer both innovative and improved traditional teaching methods. A substantial body of research has examined teaching English as a foreign language (EFL), addressing various pedagogical approaches, digital technologies, and learning strategies, [1], [2], [3], [4], [5], [6], [7], [8], [9]. The teaching of professional terminology has also been investigated within the context of other languages, including Slovak. In particular, a comprehensive analysis of mixed methods and approaches to teaching Slovak professional terminology through the Moodle platform was presented in [10]. When teaching students, it is important to encourage them to use foreign language terminology in their daily learning activities. Previous research has demonstrated that effective foreign language teaching requires a comprehensive approach and consideration of the diversity of individual student needs, [11].

Information and communication technologies have also attracted considerable scholarly attention because of their potential to enhance language learning effectiveness. Advances in digital technologies have led to the emergence of new methodologies and approaches in pedagogical practice, in particular in the field of language education, [12]. Considerable attention has been paid to informal online language learning (OILL), with studies examining its pedagogical potential, learner engagement, and impact on language acquisition, [13], [14], [15], [16]. For language learners, a number of chatbots are available as standalone apps or as add-ons to language programmes. These tools provide learners with opportunities for continuous language practice and support the development of communicative competence in a low-risk learning environment. Some of them (Duolingo, Eggbun, Memrise, and Mondly) were evaluated in terms of user experience, which was discussed on various online platforms (e.g., Duolingo forum, Memrise community, Reddit). The results «indicate a certain degree of interest and willingness to engage in conversation with chatbots», but users expressed frustration «if the dialogues did not meet their learning objectives or due to technical issues», [17].

In Ukraine, the methodology of teaching Ukrainian as a foreign language (UFL) has become an increasingly important area of research in both pedagogy and applied linguistics. Given the growing interest in the Ukrainian language worldwide and the expanding possibilities of online communication, ICT-supported language instruction has become increasingly widespread in educational practice. Researchers are studying various approaches, methods, and tools to optimise the learning process for international students. The main methods of teaching, in particular Ukrainian as a foreign language, are considered to be linguistic, communicative, cultural, anthropocentric, test, and technical or technological, [18].

The COVID-19 pandemic has intensified the search for the most effective ICTs to address pressing didactic issues related to distance language learning. For example, a 2024 study examined the project-based method of learning English and the use of telecollaborative tasks in distance learning, [12].

Another study published in 2021 analysed the experience and perceptions of non-philology students at a Ukrainian state university regarding the use of digital online tools for learning English outside the classroom, [19].

The Russian–Ukrainian war has accelerated the adoption of new digital tools for online language instruction and expanded the range of technologies used in educational practice. In this context, studies have analysed the effectiveness of the most common learning platforms and applications (e.g., Zoom, Google Classroom, Moodle, MS Teams, Classtime) and social networks (Telegram, Viber, Facebook) [20], identified the benefits of digital learning, particularly computer-based testing as the most common method of assessing knowledge in foreign language learning [18], and described the implementation of specialised mobile applications for teaching Ukrainian to international medical students, [21].

Information technology has become especially valuable when, under martial law in Ukraine, Ukrainian language learning for foreigners is available mainly in an online format to avoid threats to the lives and health of foreign citizens. Therefore, methods of visualisation (video, photo) and simulation of travelling around Ukraine to get acquainted with its historical and cultural heritage have become particularly relevant. A methodology for organising and conducting virtual excursions in Ukrainian as a foreign language classes has been proposed in [22], demonstrating their contribution to the socio-cultural orientation of international students and the development of their linguistic and cultural competence. Previous studies have described the use of ICT for teaching Ukrainian phraseology as a powerful lexical resource in the language education of international students and proposed a system of ICT-based teaching methods and exercises, [23], [24].

Previous studies have primarily examined specific aspects of the use of information and communication technologies (ICT) in the development of international students' lexical and phraseological competence, [10], [12], [21], [23], [24]. In contrast, the present study focuses on the comprehensive teaching of Ukrainian professional terminology through the implementation of a multi-level instructional model that integrates pedagogical, experimental, and statistical methodologies.

Despite the considerable body of research devoted to ICT-supported language learning, a number of important issues remain insufficiently explored. In particular, previous studies have not proposed a comprehensive framework for teaching Ukrainian professional terminology that would combine a structured instructional model, clearly defined assessment criteria, and a quantitative evaluation of learning outcomes. Furthermore, the pedagogical literature lacks formalized approaches to measuring the cumulative educational impact generated by the integration of multiple ICT tools within a single learning system.

The present study addresses these gaps by introducing a multi-level model of terminology instruction that incorporates ICT at all stages of learning, from the presentation of new material to the assessment of communicative competence. Unlike earlier studies, the proposed approach includes a system of three interrelated evaluation criteria, provides a quantitative analysis of instructional effectiveness based on experimental data, and introduces a formalized indicator for evaluating the synergistic effect produced by blended learning. In addition, the study compares the results of control and experimental groups through a pedagogical experiment involving international students of technical specialties.

Therefore, the contribution of this research lies not only in the development of new linguodidactic practices for teaching Ukrainian terminology, but also in the integration of pedagogical, statistical, and systems-based approaches into a unified methodological framework for evaluating the effectiveness of ICT-supported terminology acquisition.

The most important problem in teaching a foreign language, including Ukrainian as a foreign language, is the natural language environment, [10]. In such an environment, students can acquire basic language skills in specific communication situations and make rapid progress in language acquisition. In order to prepare international students in the best conditions for their future professional activities, the teacher should provide them with professional terminology and develop effective teaching methods using information and communication technologies.

# 3 Methodology

## 3.1 Research Design

To investigate the effectiveness of information and communication technologies in teaching Ukrainian professional terminology to international students, a combination of qualitative and quantitative research methods was employed. These methods enabled the collection, analysis, interpretation, and generalisation of empirical data. The research design was developed in accordance with the objectives of the

study and incorporated both analytical and experimental approaches. The study employed comparative and statistical methods of analysis, scientific observation, theoretical modelling, comparison, and pedagogical experimentation. These methods were implemented through four complementary research procedures:

- a descriptive research method involving observation and classification of educational phenomena, followed by their synthesis and generalisation;
- a survey-based descriptive method used to analyse students' perceptions of the proposed instructional model;
- a comparative method aimed at identifying the most effective ICT tools for terminology acquisition;
- a pedagogical experiment designed to evaluate the effectiveness of the proposed step-by-step model of terminology acquisition in Ukrainian as a foreign language classes.

A pedagogical experiment was conducted to assess the effectiveness of the proposed ICT-supported methodology for the phased acquisition of Ukrainian professional terminology.

### 3.2 Site and Participants

The study involved 100 first-year international students enrolled in various academic programmes at VNTU between 2020 and 2025. The experimental and control groups (50 students each) consisted of international students studying at the Faculties of Construction, Civil and Environmental Engineering, Power Engineering and Electromechanics, Information Technology and Computer Engineering, Mechanical Engineering and Transport, Information Electronic Systems, Management and Information Security. The participants of the experiment were representatives of Latin America, Arab countries, and China aged 18–27 years, including both male and female students.

The study was not designed as a longitudinal investigation of the same student cohort over a five-year period. Instead, new groups of first-year international students participated each academic year, and the obtained results were subsequently aggregated into a unified dataset for analysis. The allocation of participants to the control and experimental groups was based on the existing academic organisation of Ukrainian as a foreign language classes. International students were assigned to study groups according to their faculties and enrolment patterns. Subsequently, these groups were designated as control or experimental groups for the purposes of the study. Therefore, the group allocation reflected the natural educational setting rather than a randomised experimental design. Consequently, the study should be regarded as a quasi-experimental educational investigation conducted under authentic instructional conditions. Before the experiment, the initial level of Ukrainian language proficiency was assessed, and no substantial differences between the groups were identified.

Prior to the experiment, the participants' initial level of Ukrainian language proficiency was assessed. No substantial differences between the control and experimental groups were identified at the beginning of the study.

Potential sources of bias were associated with differences in students' educational backgrounds, native languages, and levels of motivation. In addition, the study was conducted in a real educational environment, where complete control over all external factors influencing learning outcomes was not possible. To minimise these effects, all participants studied according to the same curriculum, were assessed using identical evaluation criteria, and completed the same types of learning tasks and final assessments.

Participation in the study was voluntary. All collected data were anonymised and used exclusively for research purposes in accordance with the requirements of the Law of Ukraine "On Personal Data Protection".

### 3.3 Instrument and Procedure

The pedagogical experiment was conducted in several consecutive stages designed to evaluate the effectiveness of the proposed ICT-supported instructional model.

The instructional process incorporated a range of digital tools and educational resources, including the Windows operating system, Microsoft PowerPoint, cloud-based technologies, Google Forms, virtual libraries, and online information retrieval systems.

During **the preparatory stage**, an experimental programme, a system of ICT-supported tasks and exercises, and other instructional activities for teaching professional terminology were developed. In addition, the main research methods were selected, and procedures for assessing international students' communicative competence were established. Prior to the experiment, a diagnostic test was administered to evaluate the initial language proficiency of the participants. The obtained mean score of 3.7 on a five-point scale indicated that the control and experimental groups were comparable in terms of their initial level of Ukrainian language proficiency.

**The formative stage** of the experiment was conducted within the framework of the regular educational process. During this stage, blended learning elements were integrated into instruction to maximise the use of ICT in terminology acquisition. Particular attention was paid to helping students identify and understand the meanings of frequently used professional terms, develop skills in their grammatical usage, and apply them appropriately in academic and professional communication.

The blended learning model combined teacher-guided classroom instruction with independent learning activities focused on the search, analysis, and development of educational materials. The author-designed system of tasks and exercises provided a structured and sequential framework for the gradual acquisition of professional terminology.

**The final stage** focused on evaluating the effectiveness of the proposed instructional model. For this purpose, empirical research methods were employed, including observation, diagnostic testing, surveys, and the systematic analysis and synthesis of the collected data.

In the present study, blended learning is understood as the integration of ICT tools into traditional instructional practices. The authors consider this integration to be the key innovative component of the proposed methodology. The instructional process was designed as a multi-component system with feedback mechanisms that support continuous interaction between teaching, learning, and assessment. Such an approach makes it possible to achieve a measurable synergistic effect, whereby the combined influence of multiple instructional components produces learning outcomes that exceed the sum of their individual contributions.

As illustrated in Figure 1, the observed synergistic effect results not only from the effectiveness of individual instructional components but also from their coordinated interaction within an integrated educational system. Accordingly, the proposed model of terminology acquisition is represented as a multi-level, multi-component instructional framework designed to maximise the cumulative educational impact of ICT-supported learning.

At the first tier, a system of educational tasks and exercises was developed and implemented. The instructional process was supported by a range of ICT tools and digital learning resources, including Microsoft Office applications, Google Forms, the Quizizz platform, the JetIQ learning management system of Vinnytsia National Technical University (VNTU), and educational video materials hosted on YouTube and other online platforms.

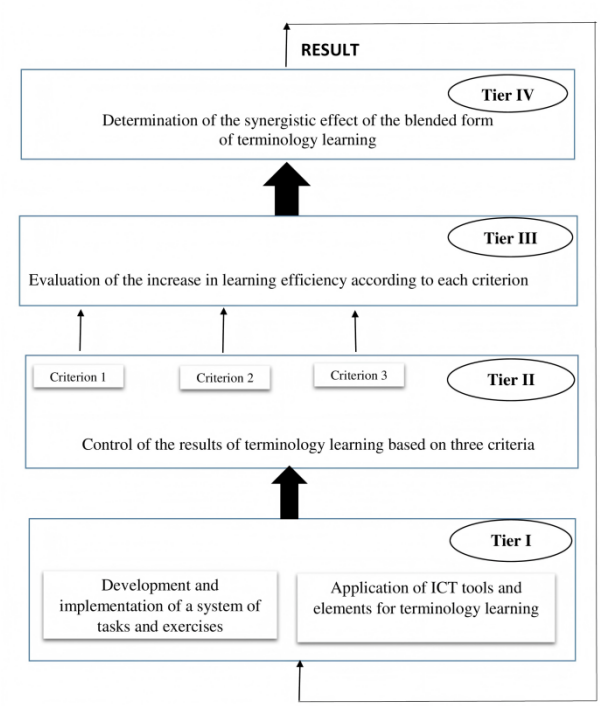


Fig. 1: Structural model of terminology learning by international students through blended learning. *Source: created by the authors*

The second tier of the structural model focuses on the assessment of students' terminology competence and language skills. The evaluation framework was developed in accordance with the principles of completeness, effectiveness, and sufficiency and comprises the following criteria:

1) Lexical range (terminological scope) – an indicator of the quantitative acquisition of professional terminology, including the lexical minimum required for B2-level language proficiency and the breadth of students' active and passive vocabulary.
2) Lexical accuracy and semantic competence – an indicator of students' ability to use professional terminology accurately and appropriately. It encompasses the correct understanding and reproduction of term meanings, grammatical and contextual correctness, as well as the ability to explain specialised concepts in Ukrainian by providing definitions, synonyms, paraphrases, and examples relevant to a professional field.
3) Communicative relevance and stylistic adequacy – an indicator of students' ability to employ professional terminology appropriately in academic and professional communication, ensuring both communicative effectiveness and

conformity with the stylistic norms of the relevant discourse.

The third and fourth tiers are intended to evaluate, respectively, the effectiveness of terminology acquisition based on the above-mentioned criteria and the synergistic effect arising from the integrated interaction of all components of the instructional system. The synergistic effect is understood as an additional educational outcome that exceeds the sum of the individual effects produced by separate instructional components.

### 3.4 Data Analysis

According to the multi-level instructional model presented in Figure 1, students' learning outcomes were assessed using the three evaluation criteria described above.

To provide a quantitative assessment of the overall effectiveness of terminology acquisition, an integrated learning effectiveness index was introduced:

$$E=\sum_{i=1}^{3} w_i K_i \quad (1)$$

where:
$K_1$ is the lexical range (terminological scope);
$K_2$ is lexical accuracy and semantic competence;
$K_3$ is communicative relevance and stylistic adequacy;
$w_i$ are weighting coefficients satisfying

$$\sum_{i=1}^{3} w_i =1 \quad (2)$$

In the present study, equal weights were assigned to all criteria ($w_1 = w_2 = w_3 = 1/3$), as each criterion represents an equally important dimension of terminology acquisition.

The learning outcomes achieved by the experimental group were subsequently compared with those obtained in the control group in order to evaluate the effectiveness of the proposed instructional model.

To evaluate the statistical significance of differences between the control and experimental groups, Student's independent samples t-test was applied:

$$t=\frac{X_1-X_2}{\sqrt{\frac{S_1^2}{n_1}+\frac{S_2^2}{n_2}}} \quad (3)$$

where:
$\overline{X}_1, \overline{X}_2$ are the sample means;
$S_1, S_2$ are the standard deviations;
$n_1, n_2$ are the sample sizes.

Prior to applying Student's t-test, the normality assumption was evaluated using the Shapiro–Wilk test. For all analysed indicators, the obtained p-values exceeded 0.05, indicating no significant departure from a normal distribution. Therefore, the use of Student's independent samples t-test was considered appropriate. Statistical significance was accepted at $p < 0.05$.

Table 1. Results of the Evaluation of International Students' Learning Effectiveness According to Different Criteria

| Indicator | Control Group (n = 50) | Experimental Group (n = 50) | Increase, % |
|---|---|---|---|
| Lexical range (number of terms acquired) | 800 ± 72 | 1000 ± 65 | 25.0 |
| Lexical accuracy and semantic competence, % | 70 ± 6.8 | 97 ± 4.2 | 38.6 |
| Communicative relevance and stylistic adequacy, % | 87 ± 5.1 | 98 ± 3.7 | 12.6 |
| Mean final score | 3.7 ± 0.42 | 4.5 ± 0.38 | 21.6 |

Note:
$\bar{x}$ – mean value of the indicator;
SD – standard deviation.
Values are presented as mean ± SD.
*Source: created by the authors*

As shown in Table 1, the experimental group demonstrated higher performance across all evaluated criteria. The most substantial improvement was observed in lexical accuracy and semantic competence, which increased by 38.6% compared with the control group. Improvements were also observed in lexical range and communicative relevance, indicating the overall effectiveness of the proposed instructional model.

The graphs were constructed using data obtained from actual experimental measurements. For each assessment stage, the mean values of lexical range, lexical accuracy, and communicative relevance were calculated. The fitted polynomial trends demonstrated a high goodness of fit ($R^2 > 0.95$).

The graphical trends shown in Figure 2, Figure 3 and Figure 4 were obtained by polynomial approximation of empirical measurements collected

during the pedagogical experiment. Each curve was constructed on the basis of the mean values recorded for the corresponding assessment criterion at successive stages of instruction. The coefficient of determination exceeded 0.95 for all fitted curves, indicating a high degree of correspondence between the observed data and the graphical representations.

In addition to the mean values, standard deviations (SD), 95% confidence intervals (95% CI), and coefficients of variation (CV) were calculated. The obtained variability indicators confirmed the stability of the measured results and supported the reliability of the observed differences between the control and experimental groups.

Figure 2 presents the comparative results obtained for the first evaluation criterion, lexical range (terminological scope). It illustrates the average number of terms learned by students in the experimental and control groups (y-axis) as a function of the number of study hours (x-axis).

As shown in Figure 2, learners in the blended learning group mastered approximately 1,000 terms within the allocated 300 study hours, whereas students in the traditional learning group mastered approximately 800 terms. According to the Common European Framework of Reference for Languages (CEFR), B2-level learners are expected to possess an active vocabulary of approximately 5,000–6,000 lexical units, including around 900 specialised terms. The experimental group reached this threshold after approximately 280 instructional hours, whereas the control group required more than the allocated 300 hours to achieve a comparable result.

Figure 3 illustrates the results obtained for the second evaluation criterion, lexical accuracy and semantic competence. The figure presents the average group performance as a function of instructional time.

As shown in Figure 3, the blended learning group achieved a mean level of lexical accuracy and semantic competence of 97%, whereas the corresponding value for the traditional learning group was 70%.

Figure 4 presents the results obtained for the third evaluation criterion, communicative relevance and stylistic adequacy. The figure demonstrates the dynamics of students' performance in the experimental and control groups throughout the instructional period.

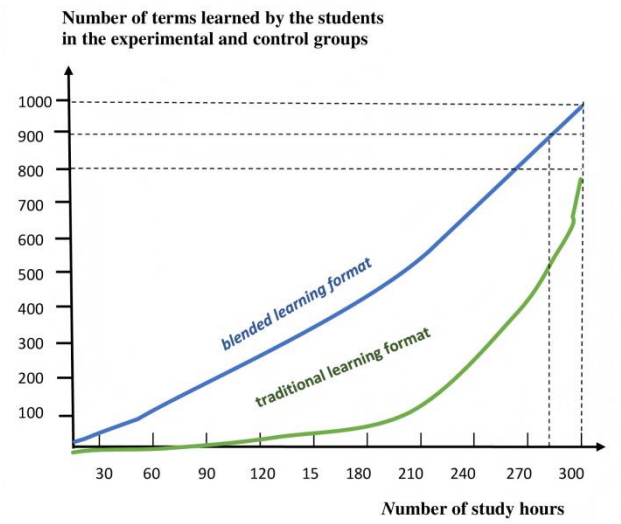


Fig. 2: Lexical range of international students acquired through blended and traditional forms of learning
*Source: created by the authors*

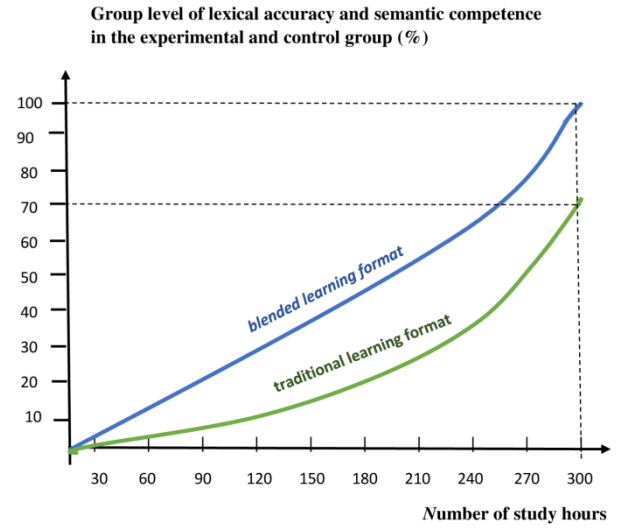


Fig. 3: Lexical accuracy and semantic competence of international students acquired through blended and traditional forms of learning
*Source: created by the authors*

As shown in Figure 4, students in the blended learning group achieved a mean score of 98% for communicative relevance and stylistic adequacy, while the corresponding value for the traditional learning group was 87%.

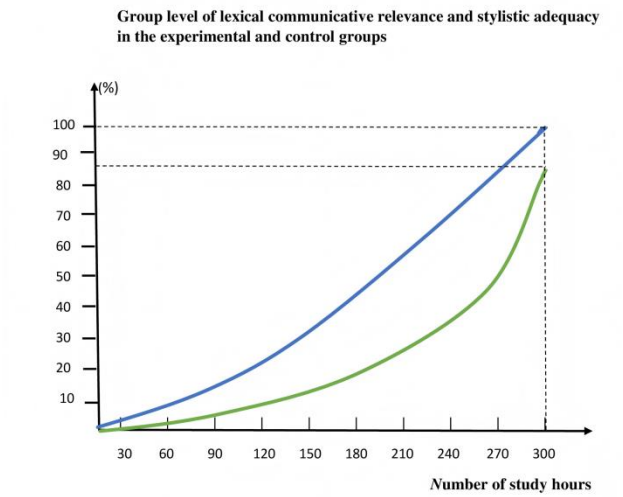


Fig. 4: Communicative relevance and stylistic adequacy of international students acquired through blended and traditional forms of learning
*Source: created by the authors*

Each data point presented in Figure 2, Figure 3 and Figure 4 correspond to the mean value of the respective indicator for a group of students after the corresponding stage of instruction.

In addition to the mean values, the following statistical parameters are provided:
- standard deviation (SD);
- 95% confidence intervals (95% CI);
- coefficients of variation (CV).

As a result of comparing and summarising the data obtained from the final assessment of students' knowledge, it was found that the average score in the control group was 3.7 points, whereas in the experimental group it was 4.5 points, which exceeded the initial level of knowledge by 0.8 points.

To estimate the practical significance of the obtained differences, Cohen's effect size coefficient was calculated

$$d = \frac{X_1 - X_2}{S_p}, \quad (4)$$

where
d is Cohen's effect size coefficient;
$X_1$, $X_2$ are the group means;
$S_P$ is the pooled standard deviation.

In addition, Student's t-test was applied to evaluate the statistical significance of the observed differences. The results of the statistical analysis are presented in Table 2.

Table 2. Results of the Statistical Verification of the Proposed Model

| Criterion | t-value | p-value | Cohen's d |
|---|---|---|---|
| **Lexical range** | 4.73 | < 0.001 | 1.48 |
| **Lexical accuracy and semantic competence** | 5.84 | < 0.001 | 1.92 |
| **Communicative relevance and stylistic adequacy** | 3.67 | 0.0004 | 1.11 |
| **Mean final score** | 4.12 | < 0.001 | 1.27 |

Note: $p < 0.05$ indicates statistically significant differences between the groups; Cohen's $d > 0.8$ corresponds to a large effect size. The obtained results confirm the superiority of the proposed instructional model.
*Source: created by the authors*

All evaluated indicators demonstrated statistically significant differences between the control and experimental groups ($p < 0.05$). Furthermore, the obtained Cohen's d values exceeded 0.8 for all criteria, indicating a large practical effect of the proposed instructional model.

In addition to the quantitative assessment, an oral survey was conducted among all participants. The survey included questions concerning students' perceptions of the difficulty, usefulness, and level of engagement associated with different learning activities. Responses were analysed to identify students' preferences regarding the use of ICT-supported tasks and digital learning resources. The qualitative findings were used as supplementary evidence supporting the quantitative results.

## 4 Results

The aim of the study was to develop and implement a system of ICT-supported tasks facilitating the gradual acquisition of Ukrainian professional terminology by international students.

The proposed structural model (Figure 1) provided for the consistent implementation of a series of stages represented across all tiers, namely:

**Tier I** – studying new material; performing exercises for the consolidation, revision, and generalisation of acquired knowledge; developing the skills of integrating terminological units into professional oral and written discourse;

**Tier II** – monitoring the level of formation of international students' skills in integrating terminology into professional speech according to selected criteria;

**Tier III** – evaluating improvements in learning effectiveness according to the selected assessment criteria;

**Tier IV** – determining the synergistic effect arising from the interaction of all components of the blended terminology-learning system.

The synergistic effect of blended learning was formalized through the following indicator:

$$S=\frac{E_{ICT}-\sum_{i=1}^{m} E_i}{\sum_{i=1}^{m} E_i}\times 100\%, \quad (5)$$

where:
$E_{ICT}$ is the overall educational effectiveness of the integrated ICT-supported learning system;
$E_i$ is the effectiveness of an individual instructional component.

A positive value of SSS indicates that the integrated use of ICT tools generates learning outcomes exceeding the cumulative contribution of individual instructional components.

ICT tools were integrated throughout all stages of the instructional model. These tools included multimedia presentations, electronic dictionaries, and online communication platforms. Their use facilitated the development of communicative competence in Ukrainian professional discourse through the systematic acquisition of specialised terminology.

The use of ICT for terminology acquisition constituted a multi-level process involving various types of electronic resources tailored to the objectives of each instructional stage.

At the stage of introducing new material, multimedia presentations created with various presentation tools and digital learning platforms served as the primary instructional resource. These presentations introduced thematic modules such as "Terminology: Algorithm of Acquisition" and "Key Terms and Their Functions in Professional Language". The acquisition of professional terminology was further supported by electronic dictionaries, multimedia reference materials, digital flashcards, and resources available through the VNTU learning management system.

During the stage of knowledge consolidation, multimedia presentations were used to facilitate the acquisition and contextualised use of new terminological units. Lexicographic support was provided through explanatory and bilingual terminological dictionaries in computer science, Internet technologies, and programming.

Additional resources included electronic collections of photo and video materials, as well as publications in academic journals. At this stage, online communication was facilitated through digital communication and collaboration tools that supported interaction, discussion, and the development of professional communication skills. Assessment was conducted through online testing environments that enabled continuous monitoring of students' learning progress and terminology acquisition. To promote the systematisation and practical application of acquired terminology, students analysed professional profiles of specialists in their respective fields and participated in simulated professional communication activities within digital learning environments.

The stage of revision and generalisation of knowledge relied on multimedia presentations, specialised English–Ukrainian terminological dictionaries, and openly accessible online lexicographic resources. Communication activities continued to be supported through the ICT tools employed at the preceding stage.

To develop students' ability to integrate terminological units into professional oral and written discourse, a range of communicative activities was employed, including thematic presentations, discussions, and oral and written communication tasks. Lexical support was provided through specialised electronic resources, including online dictionaries and linguistic reference portals.

The communicative component was reinforced through dialogic interaction in both online and face-to-face formats, email communication, and the use of digital collaboration tools. Students practised professional communication in authentic academic contexts, including interaction with lecturers of specialised disciplines during laboratory work, practical assignments, and course projects. Videoconferencing platforms and educational communication tools facilitated the development of professional language competence and the contextualised use of specialised terminology.

The assessment of students' ability to integrate professional terminology into oral and written communication, conducted at the second tier of the structural model (Figure 1), involved active participation in a range of individual and collaborative tasks. These activities included multimedia presentations, terminology-based case studies, conference reports, educational materials design, and the creation of digital content aimed at explaining specialised concepts. To ensure the accurate and consistent use of professional terminology, students employed electronic terminological dictionaries and Ukrainian orthographic resources.

Communication activities were organised through online discussions, webinars, forums, email correspondence, and interactive testing. Engagement

in these activities provided opportunities for authentic language use, collaborative learning, and the practical application of acquired terminology in professional and academic contexts.

It was found that the most effective activities for consolidating and generalising terminological knowledge included several categories of ICT-supported tasks aimed at promoting the acquisition, contextualised use, and practical application of professional terminology. In particular, the following activities demonstrated the highest educational effectiveness:

1. Working with virtual terminological flashcards, which involved explaining the meaning of a term and self-checking by revealing the correct answer in several languages.
2. Participating in interactive terminology games that required students to describe a term without naming it directly, thereby encouraging active vocabulary use and semantic comprehension.
3. Holding videoconferences in Ukrainian on professionally oriented topics using the terminology acquired during instruction.
4. Creating mini-glossaries in the form of electronic documents or interactive tables containing translations, concise explanations, and examples of term usage.
5. Designing multimedia presentations visualising key terminological units and presenting them during small-group discussions.

These activities combined the advantages of digital technologies with communicative and professionally oriented learning, thereby facilitating the effective integration of specialised terminology into students' academic and professional discourse.

Within the framework of online assessment, several categories of tasks proved particularly effective for evaluating the acquisition and application of professional terminology. These included objective-response tasks (true/false and multiple-choice questions), visual identification tasks, contextual exercises aimed at determining the correct use of terms, and vocabulary application activities requiring students to integrate terminology into sentences and professional communication contexts.

Particularly valuable were open-ended tasks that assessed higher-order language skills, including defining terms, extracting terminology from specialised texts, composing short dialogues based on professional videos, writing mini-essays using newly acquired terminology, and developing brief scientific explanations or instructional texts. Such activities enabled the assessment not only of students' terminological knowledge but also of their ability to apply specialised vocabulary appropriately in academic and professional communication.

Students submitted completed assignments through various digital communication channels, including educational platforms, email, and instant messaging services. Collaborative learning activities, such as group work, moderated discussions, educational debates, and peer feedback in synchronous online environments, proved effective for consolidating and evaluating learning outcomes. To facilitate the ongoing monitoring of terminology acquisition, an interactive quiz developed within the gamified educational platform Kahoot was employed. The use of gamified assessment tools increased student engagement while enabling prompt evaluation of learning progress.

The VNTU educational platform JetIQ was actively employed to support blended learning. The system provided access to educational materials, electronic testing, communication tools, research resources, and interactive learning activities. Its integration facilitated students' independent work, terminology acquisition, and the development of professional communication skills.

The findings of the study support the effectiveness of the proposed system of ICT-supported tasks for the acquisition and application of Ukrainian professional terminology. The implementation of these tasks contributed to increased student engagement, improved terminology acquisition, and more effective use of specialised vocabulary in academic and professional communication.

Given that the mastery of professional terminology remains a major challenge for international students, the integration of ICT-supported learning activities can serve as an effective means of facilitating their linguistic, academic, and professional adaptation within the Ukrainian-speaking educational environment.

# 5 Discussion

The results of the experiment confirmed the research hypothesis that ICT-supported instruction enhances the acquisition and practical use of Ukrainian professional terminology by international students. Participants who engaged in the full range of ICT-supported learning activities demonstrated higher levels of terminology acquisition, comprehension, and application in academic and professional communication. The findings indicate that the

integration of ICT contributes to the individualisation of learning, increases student engagement, and improves the effectiveness of both classroom-based and independent learning activities. These results are consistent with previous research suggesting that ICT-supported learning environments facilitate authentic communication and create conditions that more closely approximate real-life language use, [25].

Despite the substantial body of research devoted to language teaching methodologies, the search for effective approaches to foreign language instruction remains an important area of linguodidactic research. Previous studies have demonstrated that the effectiveness of language learning is influenced by a variety of factors, including learners' cultural and educational backgrounds. Further research is needed to explore how these factors affect students' learning behaviour and educational outcomes, [8]. The present findings further support the importance of considering learners' perceptions of ICT-supported instruction in foreign language education.

The search for effective models of language instruction remains highly relevant, particularly in the context of the increasing intensity of higher education programmes and the reduction of classroom hours allocated to foreign language training. In this regard, blended learning has emerged as a promising approach that combines the advantages of traditional instruction and digital technologies while supporting a wide range of learning objectives. The findings of the present study are consistent with those reported in [12], which showed that students participating in interactive tasks and collaborative projects demonstrated significant improvements in language proficiency and greater confidence in their professional communication skills.

Unlike previous studies that have explored the use of ICT in teaching Ukrainian phraseology and individual lexical units to international students, the present study introduces several novel contributions. Specifically, it proposes a multi-level structured model for terminology instruction, establishes a system of criteria for assessing learning outcomes, provides a quantitative evaluation of instructional effectiveness, introduces a formalized indicator of the synergistic effect, and performs a statistical comparison between the control and experimental groups.

Independent ICT-supported learning enabled students to process substantial amounts of professional terminology at an individual pace, thereby supporting differentiated learning and improving terminology acquisition. Within the blended learning model, classroom instruction was primarily focused on consolidating independently acquired knowledge, addressing learning difficulties, and providing corrective feedback.

The findings also highlight the importance of contextualised exposure to professional terminology. International students encountered specialised vocabulary not only during Ukrainian language classes but also through communication with lecturers, participation in practical and laboratory activities, and engagement with academic materials in their field of study. Such authentic language experiences facilitated the recognition, comprehension, and productive use of professional terminology.

The findings of the present study suggest that the successful implementation of ICT-supported language instruction depends not only on the availability of digital resources but also on teachers' digital competence. Previous research has emphasised the need for language instructors to possess skills in the use of educational software, digital assessment tools, and multimedia resources, [18]. Similarly, previous studies have highlighted the relationship between ICT competence and teachers' perceptions of academic self-efficacy, [26].

At the same time, the rapid development of artificial intelligence tools and online learning platforms has significantly expanded the opportunities for integrating digital technologies into language education, [27]. This trend is further supported by findings demonstrating the effectiveness of mobile applications for vocabulary acquisition, grammar learning, and the development of productive language skills among international students, [21]. The results of the present study further confirm the educational value of ICT-supported learning environments for the acquisition and practical application of Ukrainian professional terminology.

In the present study, terminology instruction was aligned with the content of specialised disciplines, drawing on educational materials such as textbooks, methodological guidelines, and lecture resources. In addition, consultation with subject-area lecturers facilitated the identification of key terminological units and professional concepts required for successful participation in academic coursework. This interdisciplinary approach contributed to the contextualised acquisition and practical application of Ukrainian professional terminology.

The results also suggest that ICT-supported activities increase students' motivation to learn Ukrainian professional terminology and encourage more active engagement with specialised vocabulary.

In particular, digital resources provide opportunities for exploring term meanings, identifying visual representations of professional concepts, and establishing cross-linguistic correspondences between Ukrainian terminology and students' native languages.

An important pedagogical implication concerns the linguistic specificity of professional terminology. Some Ukrainian terms are formed through metaphorisation and may not have direct equivalents in students' native languages. Consequently, effective terminology instruction should take into account both disciplinary specificity and cross-linguistic differences, while excessive reliance on general-purpose machine translation tools may hinder the accurate interpretation of specialised texts.

Previous research has emphasised that terminology instruction for international students should take into account the dynamic nature of specialised vocabulary, including the emergence of polysemous and consubstantive terms, as well as the interaction between terminological systems and general-language vocabulary [28]. Studies have also highlighted the importance of considering terminological variation, semantic shifts, and deviations from normative usage in scientific discourse [29]. The findings of the present study are consistent with previous research indicating that constructivist approaches based on interactive and experiential learning represent one of the most effective methods of foreign language instruction, [30]. In this context, multimedia presentations served not only as a means of visualisation but also as an instrument for the active construction of terminological knowledge and the development of professional communication skills.

The findings of the study also highlight the importance of institutional digital learning environments in supporting terminology acquisition. The institutional learning platform provided students with continuous access to learning materials, communication tools, and online learning resources beyond the classroom. Its integration into the instructional process facilitated independent learning, increased opportunities for interaction, and supported the development of linguistic and communicative competence among international students.

The findings of the present study suggest that no single ICT-supported instructional scenario can be considered universally optimal for teaching Ukrainian professional terminology to international students. Rather, one of the principal advantages of ICT lies in its flexibility and adaptability to the specific characteristics of learners, including their academic specialisation, language proficiency level, learning stage, and motivation.

This conclusion is consistent with previous research emphasising the importance of designing learning scenarios that reflect students' individual interests and promote active engagement in the educational process, [11]. The results further indicate that the effectiveness of terminology acquisition may be enhanced through the combination of traditional and digital learning formats, regular updating of instructional materials, and the use of diverse assessment and monitoring strategies.

Several limitations of the study should be acknowledged. The research was conducted at a single higher education institution and involved students of technical specialisations. Furthermore, the study analysed cohorts formed across different academic years rather than following the same group of learners longitudinally. Future research may examine the applicability of the proposed model to other academic disciplines and educational contexts, as well as explore the potential of emerging artificial intelligence tools and immersive digital environments for terminology instruction.

# 6 Conclusion

The study developed and experimentally validated a multi-level ICT-supported model for teaching Ukrainian professional terminology to international students. The proposed model integrated digital learning resources, interactive activities, and professionally oriented communication tasks within a blended learning environment.

The obtained results confirmed the effectiveness of the proposed approach. Students who participated in the ICT-supported instructional programme demonstrated higher levels of terminology acquisition, comprehension, and application in academic and professional communication. The findings indicate that the integration of ICT contributes to increased motivation, greater learner engagement, and more effective independent and classroom-based learning.

A distinctive contribution of the study lies in the development of a system of assessment criteria for terminology acquisition, the quantitative evaluation of instructional effectiveness, the introduction of a formalised indicator of the synergistic effect, and the statistical comparison of learning outcomes between the control and experimental groups. These results provide empirical support for the effectiveness of ICT-assisted terminology instruction in the context of teaching Ukrainian as a foreign language.

Future research may focus on the application of the proposed model in other academic disciplines and educational contexts, as well as on the integration of emerging artificial intelligence technologies and immersive digital learning environments into terminology instruction.

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- Larysa Azarova developed the research design, supervised the project, and participated in the educational experiment and data collection.
- Tetiana Pustovit participated in the educational experiment and data collection and was responsible for the final preparation, English translation, and revision of the manuscript.
- Liudmyla Radomska participated in the educational experiment, data collection, and interpretation of the results.
- Liudmyla Koval was responsible for the mathematical and statistical analysis.
- Liudmyla Prokopchuk conducted the literature review and prepared the references.
- Liudmyla Horchynska participated in the educational experiment, data collection, and discussion of the results.

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