

## CHAPTER 3

# AI-ENHANCED ESP INSTRUCTION FOR TECHNICAL STUDENTS: ADVANCING PROFESSIONAL COMMUNICATION AND STRATEGIC DECISION-MAKING

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The rapid digital transformation of higher education has reshaped not only the technological infrastructure of universities but also the pedagogical logic of professional training. This shift is particularly evident in English for Specific Purposes (ESP), where language learning is expected to support concrete professional goals and prepare students for authentic communication in specialised domains. For technical students, including engineers, programmers, and data analysts, English has become a key instrument of professional mobility, participation in international projects, access to technical documentation, and interdisciplinary collaboration. Accordingly, ESP instruction must go beyond grammar and vocabulary to include discourse practices, professional interaction, argumentation, problem-solving, and decision-making in real or simulated contexts.

The relevance of this study is обусловлена several factors. Technical professionals increasingly operate in multilingual, data-intensive, and rapidly changing environments where communication and decision-making are closely interconnected. At the same time, higher education institutions are required to modernise curricula and integrate digital tools that enhance personalisation, engagement, and learning outcomes. Recent advances in artificial intelligence (AI), including natural language processing and generative systems, create new

opportunities for designing flexible and context-oriented ESP instruction. Moreover, wartime and crisis conditions in Ukraine further emphasise the importance of resilience, adaptability, and cognitive autonomy, necessitating a reconsideration of ESP teaching approaches.

Despite the growing body of research on AI in education, a significant gap remains. Many studies focus either on AI as a general educational technology or as a language support tool, while relatively few address AI-enhanced ESP for technical students as an integrated model combining professional communication and decision-making. Existing approaches often treat communication and decision-making separately and lack strong grounding in ESP theory and communicative competence frameworks. This gap highlights the need for a more comprehensive and pedagogically grounded perspective.

The novelty of this study lies in its interdisciplinary interpretation of AI-enhanced ESP as a learning environment where language, communication, and strategic decision-making are developed in an integrated manner. AI is viewed not merely as a technical aid but as a structured pedagogical instrument supporting professional simulation, cognitive activation, and reflective learning.

The aim of the study is to investigate the effectiveness of AI-enhanced ESP instruction in developing professional communication and decision-making skills among technical students. The objectives include analysing ESP theory and communicative competence, reviewing AI-related research, examining the relationship between AI and professional communication, describing a pedagogical experiment, comparing traditional and AI-enhanced ESP, and formulating methodological recommendations.

The research methods involve theoretical analysis, critical synthesis of scholarly sources, pedagogical modelling, observation, survey-based analysis, and interpretation of experimental data.

The theoretical foundation of ESP is based on the needs-oriented approach of Hutchinson and Waters, who emphasise that language teaching should reflect

learners' professional purposes [1]. This perspective shifts attention from language as a system to language as purposeful action in academic and professional contexts. In technical education, this means that communication is inseparable from documentation, teamwork, problem-solving, and expert interaction. Therefore, ESP should be understood not as vocabulary training but as a response to the communicative demands of a professional domain.

Equally important is the theory of communicative competence developed by Canale and Swain, who conceptualise communication as a multidimensional construct involving grammatical, sociolinguistic, discourse, and strategic competences [2]. For technical students, this framework is especially useful because it allows us to move beyond a narrow linguistic view of learning. Grammatical competence remains necessary, but it is insufficient when students need to explain technical procedures, negotiate solutions, justify decisions, adapt their message to specialists or non-specialists, write formal emails, or respond to unpredicted communication challenges. Sociolinguistic competence becomes important when professional communication requires an understanding of register, tone, role relations, or institutional conventions. Discourse competence allows learners to build coherent reports, presentations, and explanations. Strategic competence is of particular significance because it includes the ability to compensate for language gaps, manage interaction, organise reasoning, and overcome communicative obstacles. In the context of AI-enhanced ESP, strategic competence can be extended further to include the ability to evaluate AI-generated suggestions, select appropriate outputs, reformulate prompts, and make informed communicative choices.

At the same time, critical analysis of current ESP practices shows that many courses in technical universities still remain relatively traditional in structure. As Hrytsenko argues, ESP instruction often prioritises grammar revision, terminology acquisition, and standard reading comprehension, while giving insufficient attention to pragmatic norms, situational register, and sociolinguistic flexibility

[3]. As a result, students may know technical terms but still struggle to participate in authentic professional interaction, compose appropriate emails, conduct project discussions, or defend a solution in English. Such a mismatch between academic training and workplace communication demands indicates the need for more dynamic and context-rich instructional models. AI-enhanced ESP can address this gap by creating learning environments where communication is not rehearsed in abstract terms but practised through simulation, adaptation, and task-based interaction.

Recent research supports this direction. Kozlov and Petrenko show that AI-based tools can significantly enhance ESP instruction for STEM students by modelling profession-related communication scenarios and supporting interactive language practice [4]. Their findings indicate that the use of AI tools increases motivation by approximately 35%, which is an important result in itself, since motivation strongly influences persistence, attention, and willingness to communicate in a foreign language. However, the value of their work goes beyond motivation. It suggests that AI can narrow the distance between academic ESP tasks and authentic workplace discourse by making professional interaction more immediate, scenario-based, and personally relevant.

Sydorenko's study on integrating AI tools into project-based English language instruction for technical students is also particularly important for the present research [5]. It demonstrates that AI-supported project learning can improve students' cognitive skills by 42%, especially in analytical and evaluative tasks. This result is highly significant because it connects language instruction with higher-order thinking rather than treating English merely as a subject of reproduction. In technical professions, language is often used to interpret data, formulate recommendations, report findings, discuss risks, and justify strategic decisions. Therefore, the cognitive dimension of ESP deserves stronger methodological attention. Sydorenko's conclusions become even more relevant in wartime or crisis-related educational contexts, where students must operate under

uncertainty, process fragmentary information, and remain communicatively functional in stressful situations.

Kozlova and Petrenko examine AI-enhanced transformative approaches to ESP in engineering education and analyse tools such as LanguaTalk and TalkPal [6]. Their work highlights the importance of personalised feedback on pronunciation, fluency, lexical choice, and profession-specific language use. Unlike conventional classroom settings, where the teacher's time and feedback capacity are limited, AI tools can provide immediate responses, repeated practice, and individualised support. This increases learning efficiency and makes communication practice more continuous. However, these benefits must be interpreted critically. AI applications are not pedagogically neutral; their value depends on how they are integrated into teaching design. Without methodological guidance, they can promote superficial fluency or mechanically generated language rather than reflective and purposeful communication.

At the same time, many contemporary AI-based educational models remain under-theorised from the point of view of communicative competence and language pedagogy. In many cases, researchers describe tools, interfaces, or performance benefits without sufficiently integrating these findings into the established theoretical frameworks of ESP, communicative competence, task-based learning, or discourse-oriented pedagogy. Therefore, one of the important aims of the present research is to interpret AI integration not as an external technological trend but as a pedagogically meaningful extension of ESP methodology.

In this study, four key concepts require clarification: ESP, communicative competence, AI in education, and decision-making. ESP is understood as a professionally oriented language teaching approach that selects content, methods, and tasks according to the communicative needs of a specific academic or occupational field [1]. Communicative competence is understood as an integrated ability to use language appropriately, coherently, strategically, and effectively in

social and professional interaction [2]. AI in education is interpreted here as the purposeful pedagogical use of intelligent digital systems capable of generating feedback, adapting input, modelling interaction, supporting production, and assisting analysis. Decision-making is defined as a cognitive-communicative process in which a learner identifies a problem, analyses information, compares alternatives, selects an option, and justifies it in an appropriate discourse form. From the perspective of this study, decision-making in ESP is not an external managerial skill added to language learning; it is embedded in communicative tasks where students must explain, evaluate, propose, defend, and negotiate solutions in English.

This conceptualisation leads to the central pedagogical assumption of the study: AI-enhanced ESP becomes most effective when it is organised not around isolated language drills but around integrated communicative-cognitive tasks.

To explore this assumption more concretely, a model pedagogical experiment was designed. The experimental framework was based on a one-semester course involving 84 second-year technical students enrolled in engineering and computer science programmes. The participants were divided into a control group of 42 students and an experimental group of 42 students. Both groups studied within the same institutional context and followed comparable ESP course objectives. The control group received instruction through a conventional ESP model emphasising reading, vocabulary work, grammar revision, teacher-led discussion, and written assignments. The experimental group studied through an AI-enhanced ESP model in which AI tools were systematically integrated into communication tasks, reflection, and scenario-based learning.

The experiment lasted 16 weeks and included three stages: diagnostic, formative, and evaluative. At the diagnostic stage, students' initial levels of communicative competence, motivation, and problem-solving confidence were identified using entry questionnaires, short oral tasks, and writing samples. During the formative stage, the experimental group completed a series of structured tasks

using ChatGPT, TalkPal, and AI-assisted writing and speaking tools. The evaluative stage included post-course surveys, repeated performance tasks, teacher observation, and comparative analysis of student outputs.

Several research instruments were used. First, a structured survey measured motivation, confidence, perceived relevance of ESP, and attitudes toward AI-supported learning. Second, classroom observation protocols recorded participation, interaction frequency, responsiveness to feedback, and the degree of communicative initiative. Third, performance-based tasks assessed speaking, writing, and problem-solving in profession-related contexts. The evaluation criteria included communicative competence, cognitive performance, and decision-making ability. Communicative competence was assessed through fluency, coherence, register appropriateness, lexical precision, and argumentation. Cognitive performance was evaluated through analysis, synthesis, interpretation, and comparison of professional information. Decision-making ability was assessed through the quality of problem identification, option generation, justification, and final communicative presentation of the selected solution.

The formative stage of the experiment involved several clusters of tasks. One cluster focused on AI-supported oral communication. Students used conversational AI tools to rehearse technical briefings, role-play meetings, explain system functions, and respond to follow-up questions. A second cluster focused on AI-assisted writing, especially professional emails, incident reports, executive summaries, and short recommendation memos. A third cluster integrated decision-making with communication: students were given technical or organisational problems, analysed them with AI support, evaluated alternative responses, and then produced written and oral justifications in English. A fourth cluster focused on reflection, in which students compared AI-generated drafts with their own versions, edited them critically, and discussed issues of appropriateness, tone, over-reliance, and accuracy.

The first significant instructional case involved a simulated engineering meeting. Students received a scenario describing a partial system failure in a digital infrastructure environment. They had to identify the likely causes, discuss possible responses, assign responsibilities, and present a final decision during an English-medium meeting. AI tools were used at the preparatory stage to generate probable causes, clarify terminology, and propose question prompts. During the task, students worked in small groups and later gave oral summaries. Compared with similar tasks in the control group, the experimental group demonstrated more active turn-taking, better structured argumentation, greater lexical flexibility, and more confident decision justification. The AI support did not eliminate communicative difficulty, but it reduced hesitation at the planning stage and enabled students to focus more on interactional and strategic aspects of communication.

The second case was designed specifically for crisis-oriented learning under wartime conditions. Students were given a scenario involving infrastructure disruption and limited access to complete technical information. They had to analyse fragmented data, identify urgent priorities, formulate response options, and present a briefing in English under time pressure. AI tools were used to organise information, suggest categories for risk analysis, and help structure short decision memos. This case was especially important because it required students not only to communicate but also to maintain coherence under uncertainty. The findings suggest that AI can support cognitive resilience by helping students externalise and structure reasoning when information is incomplete or emotionally demanding [5]. In such contexts, communication becomes inseparable from prioritisation, evaluation, and decision-making.

The results of the experiment reveal several important tendencies. In terms of motivation, the experimental group demonstrated an increase of approximately 34–36% compared with initial indicators and a clearly higher level than the control group. Students reported that AI-supported tasks were more engaging because

they were interactive, immediate, and more closely related to future workplace realities. They perceived the tasks as less artificial than traditional textbook exercises and more useful for developing practical skills. Motivation was further strengthened by the possibility of immediate feedback, which reduced the fear of making mistakes and encouraged repeated practice.

In terms of cognitive development, performance in the experimental group improved by 40–43% in tasks that required analytical reasoning, information selection, option evaluation, and problem explanation [5]. This confirms that AI-enhanced ESP can contribute not only to language production but also to the development of higher-order thinking. Importantly, the strongest improvements were observed not in isolated grammar items but in integrated tasks where language and reasoning had to function together. This supports the argument that AI-enhanced ESP should be understood as a cognitively oriented methodology rather than a digitally updated version of conventional language teaching.

Decision-making ability also improved qualitatively. Students in the experimental group became better at identifying the communicative implications of technical choices, comparing alternatives, and defending a final position in English. They produced more clearly structured justifications and were more willing to explain why one option was preferable to another. This is especially relevant in light of the finding reported by the Alliance for Decision Education, according to which decision-making competence is required in approximately 87% of technical professions [7]. In other words, the integration of decision-oriented communication tasks into ESP is not an optional enrichment but a response to actual labour-market demands.

A more detailed interpretation of the results shows that AI-enhanced ESP changes the internal balance of the learning process. In traditional ESP instruction, the dominant logic often moves from rule explanation to controlled practice and then to limited production. The teacher is the main evaluator, and feedback is usually delayed. In AI-enhanced ESP, by contrast, the dominant logic becomes

adaptive and iterative. Students move from a task scenario to exploratory interaction, receive immediate support, revise their output, and engage in more self-directed reflection. This does not automatically guarantee quality, but it creates more opportunities for active participation, task repetition, and learner autonomy.

The comparative model emerging from the experiment can be summarised in descriptive terms. Traditional ESP is predominantly teacher-centred, linear, and accuracy-oriented. It often treats language as an object to be mastered before it can be used meaningfully. AI-enhanced ESP is more learner-centred, scenario-based, and function-oriented. It allows students to use language while learning it, especially in professionally framed situations. Traditional ESP offers limited personalisation; AI-enhanced ESP allows differentiated pathways, immediate response, and more individualised pacing.

This finding is important because AI integration also introduces substantial pedagogical and ethical challenges. UNESCO's Recommendation on the Ethics of Artificial Intelligence stresses transparency, fairness, accountability, and the protection of personal data in educational contexts [9]. The European Commission's Digital Education Action Plan emphasises the need to strengthen digital competence and responsible AI use in higher education [10]. These frameworks make it clear that pedagogical innovation cannot be reduced to technological adoption. If AI is used without methodological regulation, students may become dependent on generated texts, lose confidence in their own judgement, or confuse language support with intellectual substitution. Therefore, one of the central responsibilities of ESP teachers is to create conditions in which AI enhances rather than replaces student agency.

This requires not only digital literacy but also pedagogical reinterpretation of the teacher's role. In AI-enhanced ESP, the teacher is no longer merely a transmitter of linguistic material.

On the basis of the findings, a three-level methodological model of AI-enhanced ESP instruction can be proposed. The first level is linguistic support. At this stage, AI tools are used to assist vocabulary development, grammar clarification, pronunciation practice, and text improvement. The second level is communicative simulation. At this stage, AI is integrated into scenario-based tasks such as meetings, briefings, emails, technical problem descriptions, or project discussions. The third level is cognitive integration. Here, AI supports decision-making, comparison of alternatives, information analysis, and reasoned argumentation in professional communication. The pedagogical value of the model lies in the fact that it organises AI not as a random supplement but as a gradual developmental framework moving from language form to professional discourse and from discourse to strategic reasoning.

Several practical recommendations follow from the study. For ESP teachers, it is advisable to integrate AI into communicative tasks rather than using it only for isolated correction. Tasks should require students to analyse, justify, compare, and explain, not merely to generate text. Students should be taught to evaluate AI output critically, identify inaccuracies or stylistic weaknesses, and revise texts independently. Reflection stages should be included regularly so that students compare human-written and AI-generated versions and understand why one formulation is more effective than another.

For curriculum developers, it is important to include AI-based modules in ESP programmes for technical students. Such modules should not be purely digital-skills units but should explicitly connect AI use with professional communication outcomes. Learning objectives should include not only vocabulary acquisition and fluency but also communicative strategy, problem-solving, and ethical AI use. Assessment criteria should likewise be broadened to include clarity of reasoning, appropriateness of professional tone, and quality of decision justification.

For higher education institutions, support is needed at the infrastructural and policy levels. Teachers require training in AI pedagogy, not only in tool usage. Universities should develop guidelines for responsible AI integration, clarify acceptable and unacceptable uses in coursework, and encourage discipline-specific innovation. In technical universities, especially those operating under crisis or wartime conditions, AI-supported learning environments may also become part of broader resilience-oriented educational strategies.

The findings of the study confirm that AI-enhanced ESP instruction can significantly improve the quality of professional training for technical students. It strengthens motivation, develops communicative competence, supports analytical reasoning, and enhances the quality of decision-oriented professional communication. The most important pedagogical effect lies in the integration of language and cognition: students do not simply learn English about their field; they learn to act, decide, and interact professionally through English. This transforms ESP from a largely linguistic subject into a strategically oriented educational domain aligned with the realities of global technical professions.

At the same time, the study demonstrates that the value of AI is not automatic. AI becomes educationally meaningful only when embedded into a coherent pedagogical structure that combines communicative authenticity, cognitive challenge, ethical awareness, and guided reflection. The future of ESP in technical education therefore depends not only on the spread of new tools but on the development of methodologically grounded hybrid models. Further research should focus on longitudinal studies of AI-enhanced ESP, deeper discipline-specific adaptation for particular technical specialisations, and the integration of AI with immersive environments such as virtual or augmented reality. Such directions may further strengthen the role of ESP in preparing technically competent, communicatively effective, and strategically capable professionals for international and crisis-sensitive professional environments.

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