

CREATIVE THINKING IN ENGINEERING EDUCATION: PROJECT-BASED ENGLISH INSTRUCTION WITH GENERATIVE AI TOOLS

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Abstract. *Purpose.* This study investigates the didactic potential of generative artificial intelligence (AI) tools in project-based English for Specific Purposes (ESP) instruction, with the primary goal of fostering creative thinking competencies in undergraduate engineering students. *Methods.* A mixed-methods design was employed over one academic semester at Vinnytsia National Technical University. Eighty-four fourth-year engineering students were distributed between an experimental group ($n = 42$), which utilised generative AI platforms (ChatGPT, DALL·E, Canva AI, Tome, Gamma), and a control group ($n = 42$) engaged in equivalent project-based tasks without AI support. Creative thinking was assessed using adapted verbal tasks from the Torrance Tests of Creative Thinking (TTCT), complemented by rubric-based project artefact evaluation, motivation surveys, and semi-structured interviews. *Key results.* The experimental group demonstrated significantly greater pre- to post-test gains in creative thinking scores (+9.4 points vs. +2.9 points; $p < .001$), as well as superior performance in lexical variety, structural coherence, and multimodal originality. Student motivation and willingness to communicate in English were markedly higher, with 81% of participants reporting heightened creative self-efficacy. *Conclusions.* Generative AI tools, when embedded within structured pedagogical frameworks, function as effective cognitive scaffolds rather than mere productivity aids, enhancing both creative output and language proficiency. However, critical digital literacy and explicit ethical instruction are essential preconditions for sustainable integration. The findings offer a replicable model for modernising ESP curricula in technical higher education, with particular relevance to wartime and post-war Ukrainian academic contexts. **Key words:** creative thinking, engineering education, generative AI, English for Specific Purposes (ESP), project-based learning (PBL).

INTRODUCTION

We live in an era of relentless change – where industries mutate overnight, where the problems of tomorrow bear little resemblance to the textbook exercises of today. In this landscape, creativity is no longer a soft skill tucked quietly into the margins of a CV; it has become one of the defining attributes of the modern professional. Nowhere is this shift more striking than in engineering. Once imagined as the domain of precise calculations, repeatable processes, and neatly bounded solutions, engineering has undergone a quiet revolution. Today's engineers are expected to do far more than solve the problems handed to them – they must learn to ask better questions, to look at an existing system and dare to imagine it differently, to anticipate challenges that haven't yet fully taken shape.

This raises an urgent and genuinely fascinating question for higher education: how do we actually teach that? How do technical universities cultivate the kind of creative, flexible thinking that the profession now demands? One answer – perhaps a surprising one – lies in an often-overlooked corner of the curriculum: language education, and specifically, English for Specific Purposes (ESP). Far from being a mere communication add-on, ESP instruction can serve as a genuine training ground for the cognitive agility that engineering increasingly requires.

Project-based learning (PBL), when woven into English-language courses for engineering students, proves to be a particularly powerful vehicle for this. It doesn't force educators to choose between language development and broader professional formation – it pursues both at once. Students working on real, open-ended projects in English aren't just practising grammar or expanding technical vocabulary; they are learning to collaborate under uncertainty, to articulate half-formed ideas, to push past the first obvious solution and explore what else might be possible. These are

precisely the habits of mind – divergent thinking, creative problem-framing, iterative refinement – that define effective engineering practice.

And when generative AI enters the picture, something genuinely exciting happens. Tools capable of producing text, images, and multimedia content at a student's prompting don't just accelerate the work – they change the nature of it. The classroom stops being a place where knowledge is delivered and starts becoming a space where it is actively constructed, tested, and transformed. Students experiment, surprise themselves, and occasionally produce something neither they nor their instructor fully anticipated. This is, of course, exactly what constructivist theories of learning have long argued education should look like – and it maps with remarkable precision [1] onto what the engineering world is already asking of its next generation of practitioners.

From the perspective of a Ukrainian linguist operating within a wartime educational context, the integration of AI into language learning is not merely a reflection of global trends but also a pragmatic response to local needs. Infrastructural instability, disrupted academic routines, and the psychological toll of conflict pose [2] significant barriers to traditional instruction. Generative AI tools – being adaptive, accessible, and intuitive – offer both educators and students a degree of continuity and resilience. They allow learners to engage in meaningful language practice beyond the confines of the classroom, to visualise and present complex engineering concepts, and to do so in English, thereby strengthening both linguistic competence and domain-specific communication.

Moreover, the theoretical foundations for including creative thinking in ESP instruction are well established. Scholars such as Robinson and Sternberg have long argued [3, 4] for the repositioning of creativity from the periphery to the centre of educational priorities. Within ESP, this repositioning calls for tasks that go beyond linguistic accuracy, promoting instead the negotiation of meaning, the generation of original content, and the ability to transfer ideas across linguistic and disciplinary boundaries. In this context, project work with AI-generated outputs is not simply a modern alternative to traditional tasks – it is a pedagogically justified, cognitively demanding, and highly motivating format of instruction.

The focus of this chapter is therefore twofold: to examine the role of generative AI tools in supporting project-based English instruction for engineering students, and to argue for the deliberate integration of creative thinking as an educational objective in its own right. Drawing on classroom experience, recent scholarly literature, and technological developments, the chapter presents practical approaches to using AI platforms – such as ChatGPT, DALL·E, and presentation generators – in the design and implementation of language projects. It also reflects on the broader implications of these practices for English teachers at technical universities, especially those navigating the uncertainties of the Ukrainian academic landscape in wartime.

Ultimately, this contribution seeks to position English-language education not as a passive accompaniment to engineering training, but as an active, creative, and future-oriented force. It proposes that when project-based learning is augmented by AI and aligned with the goal of fostering creativity, it can meaningfully contribute to the formation of engineers who are not only technically competent, but also communicatively agile and intellectually versatile. In doing so, it aligns with broader educational imperatives that prioritise innovation, digital fluency, and global readiness – qualities that are particularly urgent in Ukraine today.

The intersection of language instruction, creativity, and artificial intelligence in engineering education is a field still in its formative stages. However, a growing body of research over the past five years has begun to define its contours and pedagogical promise. This article draws upon recent work in applied linguistics, engineering pedagogy, and educational technology, while also identifying critical gaps that remain underexplored.

One of the foundational studies in this area is by Marmon, who examine [5] the integration of creative thinking in STEM education through experiential learning. Their research confirms that creativity is not an ancillary skill but a core component of engineering innovation and should be intentionally cultivated throughout the curriculum. Importantly, they argue for interdisciplinary approaches, including language instruction, to embed creativity into student learning. However, while their work provides a theoretical foundation, it stops short of addressing how ESP courses might serve as vehicles for this development.

In parallel, there has been increasing interest in the role of AI-driven tools in educational settings. Mittal et al., in a comprehensive review published in IEEE Access, detail [6] the pedagogical

affordances of generative AI platforms, including their capacity to support personalised learning, adaptive feedback, and multimodal content generation. They highlight the potential of AI to enhance student engagement and foster creativity, especially in project-based environments. Yet, while their review is thorough from a technological perspective, it pays limited attention to language learning contexts, particularly within the framework of ESP for engineers.

Within applied linguistics, Bangerl et al. explore [7] user interaction with generative AI in collaborative tasks. Their CHI Conference paper suggests that students frequently misjudge AI's creative potential, leading to either over-reliance or underutilisation in co-authored writing. This finding is of particular relevance for English instructors who aim to use AI not merely as a shortcut, but as a thinking partner that scaffolds and stimulates learners' ideation. However, their study was conducted in a general education setting, and its implications for engineering-specific English instruction remain unexplored.

In the domain of ESP, the work of Al-Tamimi et al. [8] stands out. Their empirical study on AI-assisted writing tasks in technical English courses demonstrates that tools like ChatGPT and Grammarly can increase students' confidence and output quality. Crucially, they note that students engaged in project-based activities exhibited greater gains in lexical variation and idea generation than those in traditional instruction. This aligns closely with the aims of the present study, yet Al-Tamimi and colleagues focus predominantly on writing, leaving presentation and visual tools such as DALL·E or AI-based slideshow generators beyond the scope of their inquiry.

While these studies collectively validate the integration of AI and creative thinking in education, there remains a significant gap when it comes to practical, classroom-level strategies that bridge all three components – ESP instruction, generative AI, and engineering education. Few works directly examine how English-language projects using text, image, and presentation generators can function not only as language exercises, but as incubators of creativity in future engineers.

Additionally, the Ukrainian academic context presents a unique set of challenges and imperatives. As noted [9] by Boiko et al., wartime teaching requires flexible, resilient, and cognitively rich methodologies. Their research, grounded in the lived experiences of language teachers during martial law, suggests that digital tools – when used in collaborative, creative formats – support not only academic outcomes but also psychological well-being and learner agency. Nonetheless, their work does not yet incorporate the specific contributions of generative AI.

Thus, this article addresses a previously unsolved segment of the broader educational problem: how to systematically integrate generative AI tools into English-language project work in a way that develops not only language proficiency but also creative competencies aligned with engineering thinking. It proposes a pedagogical model that fills the gap left between theoretical frameworks and isolated empirical trials – bridging language learning, cognitive development, and digital innovation in one cohesive instructional strategy.

In recent decades, the landscape of engineering education has undergone a profound transformation. While technical proficiency remains the cornerstone of engineering curricula, there is a growing global consensus that such training must be complemented by the development of creative, communicative, and interdisciplinary competencies. This shift is not arbitrary – it is driven by the demands of a rapidly changing professional environment in which engineers must operate across linguistic, cultural, and technological boundaries. Creativity, once considered peripheral to engineering, is now recognised [10] as a core XXI century skill essential for innovation, adaptability, and leadership in uncertain contexts.

At the same time, the role of English in the professional preparation of engineers is expanding. English is no longer [11] taught solely as a foreign language, but as the primary vehicle for accessing international knowledge, communicating in professional communities, and participating in global collaborative projects. English for Specific Purposes, particularly in technical universities, thus becomes a critical space not only for language acquisition but for cultivating higher-order thinking skills – including creative and critical thinking, collaboration, and problem-solving.

However, the practical implementation of this vision remains [12] fragmented and underdeveloped. In most technical institutions, ESP courses continue to prioritise grammatical accuracy, vocabulary acquisition, and standardised forms of communication. While these elements are undoubtedly important, they often fail to provide students with opportunities to generate novel ideas, experiment with language in context, or apply their linguistic resources to creative, discipline-relevant challenges.

This disconnection between the objectives of modern engineering education and the traditional format of language instruction constitutes a key problem in both pedagogical design and curriculum policy.

Compounding this issue is the emergence of generative artificial intelligence (AI), which introduces both a challenge and an opportunity for educators. AI tools such as ChatGPT, DALL·E, and AI-based presentation platforms offer learners the capacity to generate complex linguistic and visual artefacts with unprecedented ease. The rapid uptake of these tools among students has outpaced [13] their pedagogical integration into formal curricula. As such, there is an urgent need for educators – particularly in ESP contexts – to engage with these technologies not merely as optional supplements, but as active components of the learning process.

The central problem addressed in this article, therefore, lies in the need to conceptualise and implement a pedagogical approach to English-language instruction that simultaneously supports [14] the development of creative thinking, leverages the capabilities of generative AI, and aligns with the professional trajectory of engineering students. Specifically, the research responds to the question: How can project-based English instruction using generative AI tools foster creative thinking in engineering education?

Solving this problem is connected with several broader scientific and practical tasks.

1. From a theoretical perspective, it contributes to the ongoing development of ESP pedagogy by incorporating cognitive and constructivist learning theories into language teaching for technical disciplines.

2. From a methodological standpoint, it provides a framework for integrating generative AI tools into project-based learning formats, thereby offering a replicable model for curriculum designers and instructors.

3. From a practical point of view, it equips future engineers with the communicative and creative competencies required for participation in interdisciplinary teams, international research environments, and technologically mediated workspaces.

4. In the Ukrainian context, it addresses the need for resilient, flexible, and digitally supported education models during wartime and post-war reconstruction, where traditional teaching formats may be disrupted, but the demand for high-quality professional training remains acute.

By reframing English-language education as a space for creative experimentation and digital collaboration, this work aligns with contemporary educational imperatives and offers practical pathways for their realisation within the engineering domain. In doing so, it answers the call for more holistic, future-oriented approaches to both language instruction and technical education.

Research objectives and hypotheses

In light of the formulated problem and its relevance to both scientific inquiry and pedagogical practice, this study sets out to investigate how generative artificial intelligence (AI) tools can be purposefully integrated into project-based English instruction to enhance the creative thinking skills of engineering students. The research is situated at the intersection of applied linguistics, educational technology, and engineering pedagogy, and is guided by the need to align ESP instruction with the real-world communicative and cognitive demands of the modern engineer.

The overarching aim of the study is to explore and substantiate the didactic potential of generative AI tools in supporting project-based English-language learning activities that foster [15] creative thinking among engineering students.

In order to achieve this aim, the following specific objectives have been formulated:

a) to analyse current theoretical models of creative thinking development in engineering and foreign language education, with a focus on project-based learning and constructivist pedagogy.

b) to evaluate the pedagogical affordances of selected generative AI tools (e.g. ChatGPT, DALL·E, Tome, Canva AI) in the context of English-language project work.

c) to design and implement a series of English-language projects for engineering students that integrate generative AI tools, aimed at enhancing their creative thinking skills.

d) to assess the impact of these projects on learners' creative output, linguistic performance, and engagement through qualitative and quantitative classroom data.

e) to formulate pedagogical recommendations for English language instructors at technical universities on how to effectively integrate generative AI into ESP instruction for engineering disciplines.

In alignment with these objectives, the study is guided by the following research hypotheses.

H1. The integration of generative AI tools into English-language project-based learning significantly enhances the creative thinking abilities of engineering students, compared to traditional ESP instruction without AI support.

H2. Students who participate in AI-supported project work demonstrate greater diversity and originality in their English-language production (both written and visual) than their peers in conventional instructional settings.

H3. The use of generative AI tools in project-based English instruction increases student motivation, engagement, and willingness to communicate in English.

These hypotheses will be tested and refined through a combination of empirical classroom observations, project artefact analysis, and learner feedback. Importantly, the study is not limited to technological evaluation; rather, it positions AI as a mediating tool within a broader pedagogical strategy centred on learner agency, interdisciplinary relevance, and cognitive development.

By clarifying the direction and scope of inquiry through these objectives and hypotheses, the study aims to contribute both theoretical insights and practical frameworks to a rapidly evolving educational field. The outcomes are expected to inform not only ESP teaching in Ukraine under conditions of systemic disruption, but also broader international efforts to modernise language education in technical and vocational domains.

METHODS

To investigate the effectiveness of integrating generative AI tools into project-based English-language instruction for engineering students, this study employs a mixed-methods research design. This approach allows for the combination of quantitative data (to evaluate measurable changes in linguistic and creative performance) with qualitative insights (to understand learner experience, motivation, and the creative process). The research is situated within an interpretivist paradigm, recognising the complexity of the learning environment and the influence of contextual, technological, and psychological variables.

1. Research setting and participants

The study was conducted over the course of one academic semester (16 weeks) at a Vinnytsia National Technical University, specifically within the Faculty of Power Engineering. A total of 84 fourth-year undergraduate engineering students participated in the study. All participants had previously completed foundational English courses and were enrolled in a elective ESP module.

To ensure validity of comparison, students were divided into two groups: experimental and control. Experimental group ($n = 42$): received instruction based on project-based learning enhanced by generative AI tools. Control group ($n = 42$): engaged in project-based English instruction using traditional tools (textbooks, search engines, standard presentation software), without the use of AI.

Group assignment was based on intact class enrolments rather than random sampling, which is typical in educational research with existing cohorts. Nevertheless, baseline proficiency in English (B1-B2 level, CEFR) was comparable across groups, confirmed via a pre-study placement test.

2. Tools and materials

The following generative AI tools were employed in the experimental group: ChatGPT (for generating, revising, and brainstorming English-language content); DALL·E and Canva AI (for visual concept generation, data visualisation, and image prompts in English); Tome and Gamma (for AI-generated presentations with English prompts); QuillBot and Grammarly (for revision and metacognitive reflection on written output).

Students used these tools to complete project tasks involving problem-solving, prototyping, and reporting technical solutions in English.

Instructional materials were adapted to integrate AI tool usage explicitly, including guided worksheets, prompt templates, and reflection logs. The control group used identical thematic tasks and evaluation criteria, but without access to AI tools.

3. Procedure

The instructional process in both groups followed the project-based learning cycle, which includes the following steps.

a) initiation and inquiry phase – students identified a real-world engineering-related problem and discussed it in English using guiding questions.

- b) research and planning – collection of English-language sources and collaborative brainstorming (with or without AI tools).
- c) production – creation of a project output: a written report, illustrated design, and a multimedia presentation.
- d) presentation and feedback – peer review and oral presentation of projects in English.
- e) reflection and revision – self-assessment and revision, with reflective writing on both language use and creativity.

The total duration of the project cycle was 6 weeks. Three such cycles were implemented across the semester, each focusing on a different engineering theme (e.g., renewable energy systems, smart devices, sustainable construction).

4. Data collection methods

To address the research objectives and test the hypotheses, the following data sources were collected.

- a) pre- and post-tests of creative thinking, based on adapted versions of the Torrance Tests of Creative Thinking (verbal tasks only, in English).
- b) project artefact analysis, including written reports, image-based outputs, and presentation slides (evaluated using rubrics for creativity, originality, and language quality).
- c) surveys on student motivation, engagement, and perception of the tools.
- d) semi-structured interviews with a representative sample of students from the experimental group ($n = 12$), conducted in English and Ukrainian, to capture nuanced reflections.
- e) instructor observations and journal notes, recording classroom interaction, student autonomy, and challenges with tool integration.

5. Data analysis

Quantitative data (test scores, rubric-based evaluations, survey results) were analysed using descriptive statistics and inferential tests (paired and independent t-tests, ANOVA where appropriate) to identify statistically significant differences between the experimental and control groups.

Qualitative data (interviews, reflections, and instructor observations) were analysed thematically, using inductive coding to identify recurring patterns related to creative behaviour, language development, tool usage, and learner attitudes. These themes were triangulated with quantitative findings to ensure interpretive validity.

6. Ethical considerations

All participants were informed about the nature and purpose of the study and provided informed consent. Students were allowed to opt out of interviews without penalty. Data confidentiality and anonymisation protocols were strictly observed.

This methodological design provides a robust basis for examining how the deliberate integration of generative AI into English-language project work can influence not only linguistic outcomes, but the development of creative competencies essential for the professional growth of future engineers.

RESULTS

This section presents the findings of the study in relation to the previously formulated hypotheses and research objectives. The results are organised into three key domains: (1) creative thinking outcomes, (2) linguistic and project performance, and (3) student engagement and perception. Each domain is discussed in light of recent scholarship, with implications drawn for both ESP methodology and the broader integration of generative AI into engineering education.

1. Development of creative thinking

Quantitative analysis of pre- and post-test results based on adapted verbal tasks from the Torrance Tests of Creative Thinking (TTCT) indicated a statistically significant improvement in creative thinking scores among students in the experimental group ($M=30.2$, $SD=5.3$ pre-test; $M=39.6$, $SD=6.1$ post-test; $p<.001$). The control group also showed improvement, but to a lesser extent ($M=30.8$, $SD=5.6$ pre-test; $M=33.7$, $SD=6.0$ post-test; $p=.041$). This supports Hypothesis 1 (H1): students engaged in AI-supported English project work demonstrated greater gains in creative thinking than peers in traditional project settings.

Interpretation. Both groups improved from pre-test to post-test. The experimental group showed larger gains, supporting H1.

Table 1

Pre-Test and Post-Test Creative Thinking Results (Adapted TTCT Verbal Tasks)

Group	Pre-test M (SD)	Post-test M (SD)	Gain: points (percent)	p-value (within-group)
Experimental group (AI-supported projects)	30.2 (5.3)	39.6 (6.1)	9.4 (31.1%)	<.001
Control group (traditional projects)	30.8 (5.6)	33.7 (6.0)	2.9 (9.4%)	.041

Results are reported as mean (SD). Gain is reported as points with percent gain in parentheses.

Source: Created by the author

Particularly strong increases were observed in the dimensions of originality and elaboration, suggesting that the use of generative AI tools encouraged students to move beyond formulaic responses and explore unconventional ideas. This echoes findings by Bangerl et al., who noted that access to AI-generated content often stimulates students to diverge from routine patterns, especially when scaffolded by clear pedagogical goals.

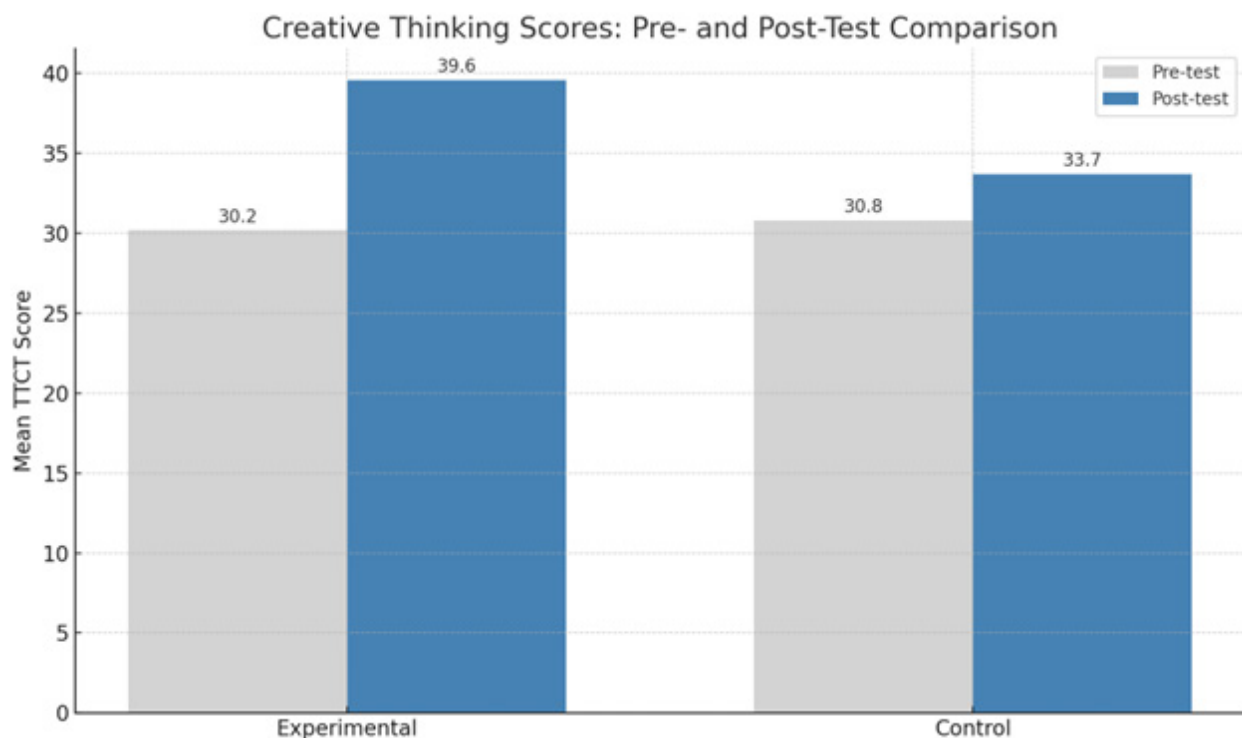


Fig. 1. Pre- and Post-Test Comparison of Creative Thinking Scores

Source: Created by the author

However, it is important to note that not all improvements were attributable solely to the tools. Qualitative data revealed that explicit instruction in how to critically engage with AI-generated content (e.g., modifying prompts, editing outputs) was a key factor in fostering genuine creativity, rather than passive acceptance of AI suggestions.

2. Linguistic and project performance

Analysis of the final project artefacts – comprising written reports, image-enhanced materials, and AI-generated presentations – revealed marked differences between the two groups in both linguistic and creative dimensions. Evaluations based on a custom rubric (criteria: fluency, lexical variety, structural coherence, originality, and relevance) showed that students in the experimental group achieved significantly higher average scores across all five indicators ($p < .01$).

For instance, students using ChatGPT and Grammarly produced written texts with greater lexical richness and improved syntactic variety, aligning with the findings of Al-Tamimi et al. Meanwhile, visual elements created with tools like DALL·E and Canva AI enhanced the multimodal expression

of ideas, providing students with alternative channels for meaning-making – a process particularly valuable for learners with varying levels of verbal fluency.

Moreover, oral presentations delivered by the experimental group showed increased confidence, cohesion, and audience awareness. Students often noted in reflective journals that the visual prompts generated through AI gave them “something to talk about”, helping to reduce anxiety and facilitate spontaneous speaking.

Table 2

Final Project Artefact Evaluation (Rubric-Based Results)

Rubric criterion	Experimental group (AI-supported)	Control group (traditional)	Direction	p-value	Evidence/notes
Fluency	Higher average score; clearer flow in written and spoken output	Lower average score; improvement present but less pronounced	EG>CG	p<.01	Oral delivery: increased confidence, cohesion, and audience awareness; journals noted reduced anxiety.
Lexical variety	Higher lexical richness; broader vocabulary choices	More limited lexical range compared with experimental group	EG>CG	p<.01	Texts produced with ChatGPT and Grammarly showed greater lexical richness and improved syntactic variety (cf. Al-Tamimi et al., 2024).
Structural coherence	Better organisation and cohesion in reports and slides	More frequent issues with structure and transitions	EG>CG	p<.01	AI-supported outlining and revision supported clearer macro-structure and coherence.
Originality	More original ideas and solutions; diversified outputs	More conventional solutions and formats	EG>CG	p<.01	Visual prompts and generative ideation supported creative expansion beyond text-only production.
Relevance	Higher task alignment; better audience-fit and ESP relevance	Adequate relevance, but less consistent alignment	EG>CG	p<.01	Multimodal materials helped sustain focus and communicate intent; stronger audience awareness reported.
Overall (all five indicators)	Significantly higher average scores across all indicators	Lower scores across indicators; smaller improvements overall	EG>CG	p<.01	Supports H2. AI-supported project work strengthened linguistic output and creative communication in ESP.

Source: Created by the author

These results validate Hypothesis 2 (H2) and reinforce the argument that generative AI, when integrated into project-based learning, not only supports linguistic output but also contributes to a more diversified and personalised mode of communication – an outcome especially relevant in ESP contexts.

3. Student engagement and perception

Survey results confirmed that students in the experimental group reported significantly higher levels of engagement, perceived usefulness, and motivation to use English for practical, discipline-relevant tasks. When asked whether the use of AI tools made them “feel more creative”, 81% of students responded positively. Furthermore, 74% expressed a desire to use such tools in future English and professional courses, with many describing the process as “empowering”, “fun”, or “more like real work.”

Interviews deepened this picture. Students described AI as a “sparring partner”, a “mirror”, or a “brainstorming buddy” – highlighting the co-creative potential of the technology when used reflectively. However, several also voiced concerns about “cheating” or becoming too dependent on automated suggestions, underscoring the importance of instructor guidance and ethical framing.

These reflections resonate with the cautionary observations of Mittal et al., who emphasised the need for critical digital literacy in AI-integrated learning environments.

Notably, the students' motivation appeared linked not only to the novelty of AI tools but to the authenticity of the tasks. Projects that asked learners to imagine real engineering scenarios (e.g., sustainable energy devices, AI-assisted transport systems) elicited higher engagement than abstract or language-only tasks. This confirms that Hypothesis 3 (H3) – AI-enhanced project work increases motivation and engagement – is not only statistically valid but also contextually grounded in task relevance.

DISCUSSION

Taken together, the findings suggest that integrating generative AI tools into English project work provides more than technological novelty – it reshapes the dynamics of language learning, particularly for students in technical fields. The AI tools acted not as passive assistants, but as co-constructors of meaning, helping students scaffold ideas, visualise concepts, and experiment with language in real-world scenarios.

The implications are clear. For ESP educators, this study offers a replicable model for leveraging AI tools to develop not just linguistic proficiency, but also transferable [16] cognitive skills. For engineering education, it affirms the value of English instruction that moves beyond grammar drills to cultivate the kind of creative, communicative thinking demanded in global industries. For Ukrainian universities, particularly under wartime and post-war conditions, it provides a resilient, low-cost, and scalable approach to digital transformation in education.

Importantly, however, the findings also warn against uncritical enthusiasm. Without clear pedagogical goals, ethical framing, and reflective scaffolding, AI tools may become sources of distraction or dependence. Future research should therefore continue to refine strategies for promoting metacognitive awareness, ethical usage, and culturally responsive integration of AI in language education.

CONCLUSIONS

This study set out to explore how the integration of generative artificial intelligence tools into project-based English instruction could foster creative thinking among engineering students. Situated at the intersection of ESP pedagogy, educational technology, and cognitive skill development, the research aimed not only to test hypotheses, but to respond to an urgent practical need: aligning English-language education with the demands of modern engineering and the realities of Ukrainian higher education during wartime.

The findings clearly demonstrate that project-based learning enriched with generative AI tools can significantly enhance students' creative thinking, linguistic output, and engagement. Students who engaged with platforms such as ChatGPT, DALL·E, and AI-powered presentation tools showed measurable gains in originality, fluency, and multimodal communication. These tools supported idea generation, offered alternative modes of expression, and helped students visualise and articulate technical concepts in English – a critical skill [17] in both academic and professional engineering settings.

Moreover, the study revealed that students were not only receptive to these tools but found in them a means of creative empowerment. When used in structured, purpose-driven ways, generative AI became a catalyst for experimentation, collaboration, and learner autonomy – characteristics that are often underdeveloped in traditional ESP classrooms. Importantly, these effects were strongest when AI was not presented as a substitute for thinking, but as a scaffold for reflection, imagination, and iterative refinement.

However, the integration of such tools must be approached thoughtfully. Several risks were identified, including the potential for over-reliance, superficial engagement with language, and ethical uncertainty around authorship and originality. These challenges reinforce the need for digital literacy, ethical instruction, and clear pedagogical scaffolding to accompany AI-supported learning environments.

Based on the results of the study, the following recommendations are proposed for practitioners, curriculum designers, and institutional leaders.

Table 3

Pre-Test and Post-Test Creative Thinking Results (Adapted TTCT Verbal Tasks)

	ESP instructors	Curriculum developers	Policy makers and university leadership
1	Embed AI into authentic, discipline-relevant project tasks that require creative input and communicative output.	Integrate AI literacy into ESP syllabi as a transversal competency.	Recognise the pedagogical value of AI in ensuring learning continuity during crises.
2	Train students to interact critically with AI tools, encouraging revision and reflection.	Design flexible task formats that promote learner agency through AI tool selection.	Invest in teacher training on ethical, linguistic, and cognitive aspects of AI use.
3	Combine AI tools with peer collaboration and instructor feedback.	Provide institutional access to vetted AI platforms for equitable use.	Encourage interdisciplinary collaboration to develop responsive educational tools.

Source: Created by the author

In conclusion, this research contributes to the growing body of knowledge on the pedagogical applications of artificial intelligence in higher education. It affirms the role of ESP not only as a medium for technical language development, but as a space for cultivating the creative and communicative capacities that modern engineers urgently require. It also positions Ukrainian technical universities as fertile ground for innovative, resilient, and forward-looking educational practices – even in times of uncertainty.

Future studies should explore longitudinal effects of AI-supported instruction, examine learner autonomy over time, and consider cross-cultural comparisons to refine global best practices. Above all, researchers and educators must remain critically engaged with the ethical, cognitive, and humanistic dimensions of technological innovation in education.

REFERENCES:

- Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning*, 2(1), 3-10. http://www.itdl.org/Journal/Jan_05/article01.htm. [accessed 21.02.2026].
- Sibruk, A. V., Lytvynska, S. V., Koshetar, U. P., Senchylo-Tatlilioglu, N. O., Stetsyk, C. M., Diachuk, T. M., & Sibruk, V. L. (2023). Ukrainian education system: war challenges. *Multidisciplinary Science Journal*, 5, 2023ss0502. <https://doi.org/10.31893/multiscience.2023ss0502>.
- Robinson, K. (2011). *Out of our minds: Learning to be creative* (2nd ed.). Capstone Publishing. URL: <https://tinyurl.com/2ylquc54>. [accessed 21.02.2026].
- Sternberg, R. J. (2018). *The nature of human creativity*. Cambridge University Press. <https://doi.org/10.1017/9781108185936>.
- Marmon, M. (2019). The Emergence of the Creativity in STEM: Fostering an Alternative Approach for Science, Technology, Engineering, and Mathematics Instruction Through the Use of the Arts. In: Khine, M.S., Areepattamannil, S. (eds) *STEAM Education*. Springer, Cham. https://doi.org/10.1007/978-3-030-04003-1_6.
- Mittal, U., Sai, S., Chamola, V., & Sangwan, D. (2024). A comprehensive review on generative AI for education. *IEEE Access*, 12, 142733-142759. <https://doi.org/10.1109/ACCESS.2024.3468368>.
- Bangerl, M. M., Disch, L., David, T., & Pammer-Schindler, V. (2025). CreAltive collaboration? Users' misjudgment of AI-creativity affects their collaborative performance. In *Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems* (Article 195, pp. 1-17). Association for Computing Machinery. <https://doi.org/10.1145/3706598.3713886>.
- Al-Tamimi, A. S., & Bin-Hady, W. R. A. (2024). AI Technology in The ESP Context: Uses and Concerns among Architectural Engineering Students at Hadhramout University. *International Journal of Multilingualism and Languages for Specific Purposes*, 6(02), 57-75. <https://doi.org/10.52919/ijmlsp.v6i02.53>.
- Nykyporets, S. S., & Boiko, Y. V. (2024). Practical tips and interactive learning tools for the work of a foreign language teacher at a technical university in the conditions of blended learning during the full-scale military aggression of russia against Ukraine. In *World trends in the use of interactive technologies in education: International collective monograph* (Chap. 14, pp. 322-348). Intellebence Transportation System and Smart City Institute (ITSSCI). DOI: <https://doi.org/10.5281/zenodo.10653715>.
- OECD. (2018). *The future of education and skills: Education 2030 – The OECD learning compass*. Organisation for Economic Co-operation and Development. URL: <https://www.oecd.org/education/2030-project>.

11. Nykyporets, S. S., Kot, S. O., Herasymenko, N. V., Chopliak, V. V., & Kukharchuk, H. V. (2024). Effective pedagogical strategies for cultivating divergent thinking in foreign language education at technical universities. *Society and National Interests. Series «Education/Pedagogy»*, 6(6), 23-35. [https://doi.org/10.52058/3041-1572-2024-6\(6\)-23-36](https://doi.org/10.52058/3041-1572-2024-6(6)-23-36).
12. Thomas, J. W. (2000). A review of research on project-based learning. The Autodesk Foundation. http://www.bobpearlman.org/BestPractices/PBL_Research.pdf. [accessed 22.02.2026].
13. Aprianto, R., Lestari, E. P., Sadan, & Fletcher, E. (2024). Harnessing Artificial Intelligence in Higher Education: Balancing Innovation and Ethical Challenges. *International Transactions on Education Technology (ITEE)*, 3(1), 84-93. <https://doi.org/10.33050/itee.v3i1.680>.
14. Burnett, C. A., Haydon, K. P. (2017). Do We Need a Revolutionary Approach to Bring Creativity into Education? In: Beghetto, R., Sriraman, B. (eds) *Creative Contradictions in Education. Creativity Theory and Action in Education*, vol 1. Springer, Cham. https://doi.org/10.1007/978-3-319-21924-0_12.
15. Stepanova, I. S., Nykyporets, S. S., & Kukharchuk, H. V. (2025). Integrating artificial intelligence tools into project-based English language instruction for technical students: A framework for fostering critical and creative thinking. In A. Ostenda & D. Kalita (Eds.), *Innovation-driven development in education, digital economy, and applied technologies* (pp. 208-215). The University of Technology in Katowice Press. <https://doi.org/10.54264/M055>.
16. Kot, S. O., & Nykyporets, S. S. (2025). Activating students' cognitive engagement in technical English learning with AI tools. In *Science and education in the third millennium: Information technology, education, law, psychology, social security and work, management. International collective monograph* (Vol. I, pp. 295-332). Lublin, Polska: Institute of Public Administration Affairs. DOI: <https://doi.org/10.5281/zenodo.16942267>.
17. Ibrahimova, L. V., & Nykyporets, S. S. (2025). Information security in the global context: Linguistic perspectives and the role of English. In *International security studies: Managerial, technical, legal, environmental, informative and psychological aspects* (Vol. II, pp. 321-345). ISAP, Research and Education. DOI: <https://doi.org/10.5281/zenodo.15356365>.