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ЗМІСТ

Впровадження STEM/STEAM-моделі у підготовку майбутніх рятувальників у закладах освіти цивільного захисту
Архипенко В. О. **5**

STEM-освіта як засіб розвитку критичного мислення та цифрових компетентностей здобувачів освіти
Бабкова Н. В. **7**

Концептуальна модель бази даних платформи E-learning для набуття STEM та STEAM навичок
Джоші О. І. **11**

STEAM-освіта і дизайн-мислення в підготовці фахівців інформаційної сфери
Дубовик Н. А. **14**

Використання STEAM технологій для вивчення розділу «Бази даних» в закладах загальної середньої освіти
Жидик В. Б. **17**

Роль STEAM освіти у діяльності юриста
Зеленський С. М. **20**

Використання інтерактивних цифрових платформ для впровадження STEAM-освіти на уроках початкової школи
Кудрасевич О. В. **22**

Значення STEM-освіти в кар'єрній орієнтації майбутнього соціолога
Лапіна В. В. **26**

STEM as a tool for developing research and communicative competencies in students: theoretical justification and systematization of practical models
Marukhlenko O. V. **30**

Поєднання традицій і інновацій: STEM/STEAM-освіта на основі дитячого фольклору
Марчун О. В. **34**

Напрями формування готовності майбутніх вихователів до реалізації технологій STREAM в закладах дошкільної освіти
Матішак М. В., Захарасевич Н. В. **37**

English as a tool for preparing STEM students to participate in international projects for rebuilding Ukraine's energy infrastructure
Nykyporets S. S. **41**

Selection of materials and methods in the process of scientific research
Pivkach I. O. **46**

Міждисциплінарні інтегровані уроки в сучасній освіті
Сікора О. В. **48**

Застосування CAT-інструментів у перекладацькому процесі
Сітко А. В. **51**

STEAM approach in teaching agrarian and land law
Stanislavskyi V. P. **55**

Проєктно-орієнтоване навчання як основа впровадження STEM та STEAM-освіти
Угольнікова Н. С. **57**

Шляхи перетворення оксидів вуглею в метанол як сировинно-енергетичний акумулятор в динамічних умовах синтезу
Хімач Н. Ю., Євдокименко В. О. **62**

Впровадження STEM та STEAM підходів у систему професійної підготовки поліцейських в Україні
Червінчук А. В. **66**

Впровадження філософії STEM у викладанні іноземних мов
Чернова Ю. В. **69**

Використання платформи Arduino у підготовці майбутніх учителів фізики та математики в умовах STEM-освіти
Яремій І. П., Яремій С. І., Повх М. М. **71**

ENGLISH AS A TOOL FOR PREPARING STEM STUDENTS TO PARTICIPATE IN INTERNATIONAL PROJECTS FOR REBUILDING UKRAINE'S ENERGY INFRASTRUCTURE

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Russia's full-scale war against Ukraine has turned the energy system into a constant frontline target, with repeated large-scale missile and drone strikes in 2024–2025 destroying thermal power plants, damaging hydroelectric facilities, leaving civilians without electricity, water, and heating, and forcing emergency blackouts across multiple regions. Rebuilding and stabilising this energy infrastructure is not just a matter of repair but a strategic priority for national survival, because Ukraine must rapidly restore damaged generation capacity, protect transmission networks, and at the same time redesign the grid to be more modular, modern, and resilient in line with European standards.

This urgent technical agenda is already international by nature: reconstruction projects are financed, supervised, and engineered together with foreign partners, global donors, and private energy companies, which means that English is the shared working language in design reviews, safety documentation, procurement, and project reporting. In this context, English for engineering students in Ukrainian STEM programs – electrical engineers, power systems specialists, IT network security analysts, environmental engineers – functions not as a school subject but as an operational tool for participation in real joint projects [1] that repair substations, deploy temporary generation, integrate renewables, and report on risks under active shelling.

This article argues that English for Specific Purposes tailored to energy reconstruction tasks can accelerate Ukraine's recovery by preparing future engineers to communicate technical decisions clearly to international partners, contribute to designs for distributed and renewable generation that is harder for the enemy to disable, and act as competent representatives of Ukraine in the long-term rebuilding of critical infrastructure after and during war.

The core problem is that traditional English instruction at technical universities in Ukraine is still largely focused on grammar, reading comprehension, and general conversational topics, while the real national

demand – under conditions of ongoing military aggression and systematic attacks on critical infrastructure – is for engineers who can operate immediately in English inside multinational reconstruction teams working on power generation, transmission security, smart grids, and emergency backup systems. This gap is not linguistic only – it is strategic – because if future electrical engineers, energy system designers, cyber security specialists, and environmental safety experts cannot clearly present technical risks, defend design choices, and comply with inter national regulatory language, Ukraine slows down its own reconstruction and becomes more dependent on foreign contractors to speak for it in negotiations, planning meetings, and safety reviews. The scientific and practical task is therefore to redesign English for Specific Purposes not as a support subject but as an applied instrument of national recovery, aligning language learning with authentic project documentation, site reporting from damaged facilities, cross-border procurement procedures, and joint planning for a future grid that must be both European in standards and wartime-proof in architecture.

Recent studies in Ukrainian higher education show a clear shift from treating English as a general foreign language toward using it directly as a working instrument in technical fields, with approaches like CLIL (Content and Language Integrated Learning) and EMI (English-Medium Instruction) being introduced [2] in engineering specialities specifically to align language training with domain knowledge and international standards, even under wartime conditions that demand institutional resilience.

Researchers also note that English is the operational lingua franca in engineering teams, and that future power engineers must be able not only to read technical documentation but to negotiate, report incidents, explain risks, and coordinate with foreign partners in real time, because global infrastructure projects, including those in energy and grid recovery, are coordinated across borders [3] using English as the default medium. At the same time, recent work on integrating renewable energy and power systems vocabulary into English curricula for electrical engineering students shows [4] both progress and limitations: students are being exposed to terminology related to energy generation, system stability, and sustainability, but the instruction often remains lexical and classroom-bound instead of being embedded in live project communication tasks such as damage assessment reports, grid restoration briefs, or safety justifications for temporary generation units.

Parallel Ukrainian and international analyses argue [5] that language education during wartime must explicitly support resilience, psychological stability, and motivation, because students are learning under air raid alerts, infrastructure disruption, and personal insecurity, which means that

communicative competence in English is not an abstract academic goal but a survival skill for professional continuity in crisis.

However, what remains unsolved – and what this article addresses – is the design of an English for Specific Purposes model that directly prepares STEM students in Ukraine to participate in international reconstruction projects in the energy sector, where they must communicate about damaged assets, grid vulnerabilities, and technical recovery plans under active threat, a context only partially covered by general ESP/EMI reforms and not yet formalised as a systematic pedagogical framework in current publications.

The purpose of this article is to define and justify a targeted model of English for Specific Purposes that prepares Ukrainian STEM students – especially future power and energy engineers – to participate effectively in international projects for the restoration, modernization, and protection of Ukraine's energy infrastructure under wartime and post-war conditions.

The main material of the study is based on an experimental ESP model that treats English not as a subject of memorisation but as an operational instrument for participation in real energy recovery projects, and it was implemented with 89 fourth-year students of the Faculty of Energy over one and a half academic years in the context of constant pressure on Ukraine's power system. In this model, communication tasks were designed to mirror actual work situations: students were asked to draft fault reports for a damaged substation, argue [6] for the choice of a specific temporary generation unit in a critical district, and prepare a short English briefing for international partners explaining risks to grid stability if one transformer is lost.

The language focus in these tasks did not stop at vocabulary lists like "primary winding" or "frequency converter" but required students to connect technical facts with accountability statements, for example "this component must be replaced within 48 hours to prevent cascading failure of the feeder line," which reflects the real logic of energy infrastructure protection and not textbook politeness.

A second block of the model simulated cross-border cooperation: students worked in Ukrainian-English pairs where one student played the role of site engineer and the other played the role of external auditor, and they had to resolve [7] a supply bottleneck in English, negotiate delivery priorities, and justify why one repair should happen before another; this reproduced the asymmetry of responsibility that Ukrainian engineers already face in joint infrastructure projects.

A third block addressed security-sensitive communication, because in wartime conditions engineers cannot always say everything openly: students practiced distinguishing between what may be shared with an external technical partner ("Transformer T3 suffered overheating due to load

redistribution") and what must remain internal ("The overload was caused by deliberate enemy action against line 110 kV"), which is essential both for physical security and for trust in cooperation. Quantitatively, students trained under this model showed a measurable shift in communicative performance: when evaluated in simulation interviews by independent instructors, they produced on average 37 percent more complete and structured English justifications of technical decisions than the control group that studied standard technical English without project simulation.

Qualitatively, examiners noted that the experimental group stopped "*translating in their heads*" and instead started "*thinking in project language*", for example answering "This failure is critical because it isolates the hospital district" rather than listing general definitions of "*critical load*". The results also indicate that students became more confident in using English to express engineering risk, which is exactly the communicative zone where Ukrainian specialists are often forced to remain silent in multinational meetings because they fear making a technical mistake or causing reputational damage to their institution. Importantly, these gains did not depend on perfect grammar but on the ability to describe status, risk, mitigation, sequence, and responsibility, which means that the linguistic target for energy reconstruction English should not be native-like fluency but operational clarity under stress. From a scientific standpoint, the study shows that integrating realistic reconstruction scenarios into ESP directly supports national recovery tasks by preparing graduates who can already operate in English inside multinational energy projects, and from a pedagogical standpoint it suggests that English for engineers in wartime Ukraine must be rebuilt around infrastructure survival, not around abstract "communication skills."

The study demonstrates that English for Specific Purposes built around real tasks of energy infrastructure recovery – damage reporting, technical justification, risk communication, coordination with foreign partners – measurably improves the ability of Ukrainian STEM students to function as competent participants in international reconstruction projects, even before graduation. This proves that for a country under attack, language training in engineering is not an auxiliary discipline but an element of infrastructure resilience, because it directly affects how fast and how convincingly Ukraine can argue for resources, explain priorities, and defend technical decisions in multinational settings. Further research must formalise this approach as a scalable curriculum for technical universities, develop specialised English modules for cyber security of energy systems and for renewable and distributed generation, and test long-term outcomes in real joint projects with industry partners rather than only in controlled simulation.

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