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DEVELOPING ENGLISH LANGUAGE COMPETENCE IN FUTURE PROFESSIONALS IN ELECTRONIC COMMUNICATIONS AND RADIO ENGINEERING: EU EXPERIENCE

ABSTRACT

In today's era of global digitalisation, specialists in electronic communications and radio engineering must function effectively in multilingual and multicultural professional environments, where English is the primary language of technical documentation, scientific research, and innovation. Ukrainian higher education faces a challenge: while students often possess strong technical knowledge, their limited English proficiency restricts access to international publications, participation in global projects, and academic mobility. This article analyses European practices that integrate English language development with engineering education, including Content and Language Integrated Learning (CLIL), English-Medium Instruction (EMI), project- and task-based learning (PBL/TBL), and blended and flipped learning approaches. Case studies from Austria, the Czech Republic, Norway, and Poland demonstrate that combining these methods enhances students' technical understanding, professional communication, and intercultural competence. Embedding English within technical curricula, engaging students in authentic engineering tasks, and employing digital tools and virtual labs fosters active use of English in context, strengthens domain-specific vocabulary, and improves reporting and presentation skills. Adapting such practices in Ukrainian programmes requires teacher training, curriculum redesign, institutional support, and partnerships with international universities and industry. A coordinated, multi-method approach can significantly boost students' employability, readiness for global collaboration, and ability to meet European engineering standards.

For Ukrainian higher education, adopting these practices represents a critical opportunity to close the linguistic gap that currently limits students' academic mobility, employability, and international engagement. Further research could explore the long-term effectiveness of integrated methods and the role of digital tools and international projects in enhancing professional English skills and technical competence in Ukraine.

Keywords: English for Specific Purposes, electronic communications, radio engineering, CLIL, EMI, project-based learning, blended learning, higher education, Ukraine, internationalisation, European Union.

РОЗВИТОК АНГЛОМОВНОЇ КОМПЕТЕНТНОСТІ
МАЙБУТНІХ ФАХІВЦІВ З ЕЛЕКТРОННИХ КОМУНІКАЦІЙ І РАДІОТЕХНІКИ: ДОСВІД КРАЇН ЄС

АНОТАЦІЯ

У сучасну епоху глобальної цифровізації фахівці з електронних комунікацій та радіотехніки повинні ефективно діяти в багатомовних і мультикультурних професійних середовищах, де англійська мова є ключовою для технічної документації, наукових досліджень та інновацій. Система вищої освіти України стикається з проблемою: попри ґрунтовні технічні знання, обмежена англомовна компетентність студентів ускладнює доступ до міжнародних публікацій, участь у глобальних проєктах і академічну мобільність. У статті досліджено європейські практики інтеграції розвитку англійської мови з інженерною освітою, зокрема навчання за принципом Content and Language Integrated Learning (CLIL), англомовне викладання (English-Medium Instruction, EMI), проєктне та завдання-орієнтоване навчання (PBL/TBL), а також змішані та перевернуті моделі навчання. Досвід Австрії, Чехії, Норвегії та Польщі демонструє, що поєднання цих підходів значно підвищує технічну компетентність студентів, їхню професійну комунікацію та міжкультурну обізнаність. Зазначено, що інтеграція англійської мови в технічні освітні програми, залучення студентів до реальних інженерних завдань та застосування цифрових інструментів і віртуальних лабораторій сприяє активному використанню мови, розвитку фахової термінології та вдосконаленню навичок складання звітів і презентацій. Адаптація цих практик в українських ЗВО потребує підготовки викладачів, редизайну навчальних планів, інституційної підтримки та партнерства з міжнародними університетами й промисловістю. Встановлено, що координований підхід може суттєво підвищити конкурентоспроможність студентів, їхню готовність до міжнародної співпраці та відповідність європейським стандартам інженерної освіти. Для української вищої освіти впровадження цих практик є критично важливою можливістю подолати мовний розрив, який наразі обмежує студентів у їхньому працевлаштуванні та міжнародній діяльності. Перспективи подальших досліджень полягають в оцінюванні довгострокової ефективності інтегрованих методів і ролі цифрових технологій та міжнародних проєктів у розвитку професійної англомовної компетентності та технічних навичок у системі вищої освіти України.

Ключові слова: *англійська мова за професійним спрямуванням, електронні комунікації, радіотехніка, CLIL, EMI, проєктне навчання, змішане навчання, вища освіта, Україна, інтернаціоналізація.*

INTRODUCTION

In the era of global digitalisation, specialists in electronic communications and radio engineering must operate confidently in multilingual and multicultural environments. English has become the universal language of professional communication, technical documentation, scientific research, and innovation exchange. Developing English competence among future engineers is therefore not merely a linguistic goal but a strategic component of professional training and employability (Aswirawan & Lawi, 2022). These fields are among the fastest-evolving technological domains, requiring continuous access to international knowledge, participation in transnational research, and collaboration with global engineers, scientists, and companies. Most scientific literature, technical standards,

patents, and software documentation are published in English, making proficiency essential (Cantwell & Shukla, 2025).

In the context of European integration and a growing digital economy, Ukraine's higher education system faces the challenge of preparing competitive specialists for international environments. Despite reforms introducing competence-based approaches, the linguistic component of technical education remains underdeveloped. Many Ukrainian students have solid technical knowledge but struggle with English manuals, publications, or presenting findings internationally, limiting academic mobility, employment prospects, and participation in global innovation networks. Studying and adapting successful European practices in English language training is therefore crucial for Ukraine. Improving English education for future specialists will strengthen academic internationalisation, technological advancement, and Ukraine's participation in the global digital community..

THE AIM OF THE STUDY

The article aims to analyse effective European practices for developing English language competence among students of electronic communications and radio engineering and propose recommendations for improving English-mediated professional training of future engineers in Ukraine.

THEORETICAL FRAMEWORK AND RESEARCH METHODS

The development of English language competence in future specialists in electronic communications and radio engineering relies on applied linguistics, English for Specific Purposes (ESP), and contemporary pedagogical approaches in higher engineering education. ESP theory highlights the importance of aligning language instruction with learners' professional needs, focusing on mastery of domain-specific terminology, comprehension of English manuals and research, and effective communication in international academic and professional contexts (Chaovanapricha & Champakaew, 2024).

Content and Language Integrated Learning (CLIL) embeds English instruction within technical curricula, fostering simultaneous acquisition of subject knowledge and language competence (Nguyen et al., 2025). Successful European implementations, including Austrian-Czech initiatives, demonstrate improvements in technical understanding, professional vocabulary, and intercultural competence (VŠTE Institute for Technology and Economics, Budweis & FH Oberösterreich, 2025a; 2025b). English-Medium Instruction (EMI) further promotes immersion in content courses conducted in English, enhancing reading, writing, and oral skills while supporting interaction with international publications, standards, and collaborative projects (Lin & Lei, 2021; Karabay & Durrani, 2024; Orduna-Nocito & Sánchez-García, 2022).

Project-based learning (PBL) and task-based learning (TBL) situate English use within authentic professional tasks, such as system design, simulations, or presentations. European case studies, including NTNU Engineering Ladder in Norway (EIT HEI Initiative, 2023) and the IoT Engineering programme at Warsaw University of Technology (Kraśniewski, 2025), illustrate how PBL/TBL develops technical skills, professional communication, and intercultural competence. Blended and flipped learning models support student-centered, technology-mediated learning, integrating subject content with English practice through digital tools, virtual labs, online simulations, and technical corpora, while maximizing in-class engagement (Mizza et al., 2025).

This framework also draws on communicative competence theory, emphasizing linguistic, pragmatic, and strategic skills for effective professional interaction in English (Aladini & Gheisari, 2025; Mao & He, 2021). By integrating ESP, CLIL, EMI, PBL/TBL,

and blended/flipped approaches, language learning becomes inseparable from technical education, enabling students to develop professional and linguistic competence. To address this problem and propose effective solutions within European and Ukrainian scientific discourse, methods such as theoretical analysis, deduction, induction, systematization, and generalization were employed.

RESULTS

The investigation of English language instruction for students in electronic communications and radio engineering highlights a persistent gap: while many Ukrainian students have strong technical knowledge, they often struggle with English manuals, research publications, and international presentations. This limits their academic mobility, employment opportunities, and participation in global collaboration and innovation networks. A detailed analysis of successful European tertiary engineering education shows that combining pedagogical strategies, rather than relying on a single method, is most effective in developing English-mediated professional competence. The following discussion presents these approaches with real-world examples and considers their combined applicability for the Ukrainian context.

In the cross-border *CLIL – content and language integrated learning* initiative between Austria and the Czech Republic, technical degree programmes in informatics, logistics, civil and mechanical engineering were enriched with multilingual modules in German, Czech and English (VŠTE Institute for Technology and Economics, Budweis & FH Oberösterreich, 2025b). For instance, 48 teaching and learning modules and multilingual glossaries were developed to integrate language and subject content (VŠTE Institute for Technology and Economics, Budweis & FH Oberösterreich, 2025a). Students in these programmes improved not only their technical knowledge but also domain-specific vocabulary and intercultural competence. Within this study, applying a CLIL approach to Ukrainian electronic communications/radio engineering curricula could embed English language development directly into technical course modules, thereby strengthening students' ability to engage with English-language technical materials.

Even though detailed case-studies of *English-Medium Instruction* (*EMI*) in engineering are less prominent in the sources accessed, the trend across European higher education is clear: instruction in English for content courses accelerates both discipline-specific understanding and English language proficiency (Lin & Lei, 2021). By situating the technical subject in the medium of English, students must process complex engineering concepts in English, enhancing their reading, writing and oral skills in the professional register. Adapting EMI into Ukrainian programmes implies delivering lectures, seminars or labs in English (or partially bilingual), targeting students' ability to work with international specifications, publications and communication in the global engineering community.

The Norwegian University of Science and Technology (NTNU) Engineering Ladder initiative, for example, uses *project-based learning* (*PBL*) *and task-based learning* (*TBL*) in electrical engineering to engage students with real-world 'wicked' problems and external stakeholders (EIT HEI Initiative, 2023). Their research shows that PBL/TBL assignments lead to positive student learning outcomes, improved motivation, and effective formation of professional competencies. Similarly, the "Internet of Things (IoT) Engineering" programme at the Faculty of Electronics and Information Technology, Warsaw University of Technology, demonstrates how PBL can be systematically embedded across the engineering curriculum. From the first year onwards, students engage in open-ended, real-world tasks such as designing and implementing IoT prototypes, including

sensors, wireless modules, and network communication systems (Kraśniewski, 2025). This approach not only reinforces technical knowledge but also promotes the development of communication, documentation, and presentation skills in English, essential for participation in international professional environments.

For Ukrainian students specialising in electronic communications and radio engineering, these European models provide valuable guidance. Embedding PBL/TBL tasks, such as prototyping communication systems, documenting their operation in English, presenting results to peers or external stakeholders, and reflecting collaboratively on design choices, enables active use of English in authentic problem-solving contexts, enhancing both technical competence and professional language skills.

While the literature offers fewer specific engineering-English case studies labelled as *"blended"* or *"flipped"*, it is clear that digital tools (virtual labs, online simulations, technical corpora) and flipped-classroom structures support the integration of subject content and language learning (Mizza et al., 2025). For example, within the Austrian-Czech CLIL project, e-learning modules and digital flashcards for technical terminology were created (VŠTE Institute for Technology and Economics, Budweis & FH Oberösterreich, 2025a; 2025b). A flipped classroom approach for Ukrainian students could entail pre-class English-mediated reading of technical texts and online modules, followed by in-class workshops where students use English to discuss, design and present engineering tasks.

However, the evidence from European engineering education underscores that no single method suffices to generate robust English-mediated professional competence; rather, a synergistic integration of approaches is required (Holgaard et al., 2023). CLIL embeds language within content; EMI immerses students in English for technical study; PBL/TBL engage them in real-world tasks using English; blended/digital and flipped models increase flexibility, student autonomy and interaction in English. When adapted for Ukrainian higher-education programmes in electronic communications and radio engineering, this combined methodological toolkit can produce measurable improvements: students who can interpret English-language technical documentation, write reports in English, present findings internationally, and collaborate within global engineering networks. Moreover, the strategic significance of these improvements extends beyond individual student outcomes. Strengthening English-language competence in technical disciplines supports Ukraine's higher-education internationalisation, aligns specialist training with European engineering and digital economy standards, and enhances graduates' employability and mobility in the integrated European and global labour market.

From a pedagogical perspective, implementing such a diverse blend of methods necessitates institutional support: curriculum redesign, teacher professional development in CLIL/EMI, development of English-medium materials in electronics/radio engineering, access to digital tools and virtual lab platforms, and establishing partnerships that enable authentic PBL/TBL in English (Zoghbor & Alexiou, 2020). Future research might track longitudinal outcomes such as graduates' employment, mobility and participation in international innovation networks, and investigate which combinations of methods (e.g., CLIL + flipped + PBL) are most effective in the Ukrainian technical-education context.

Thus, adapting the European practices reviewed here offers a practical and evidence-based pathway for developing English language competence in future specialists in electronic communications and radio engineering in Ukraine, thereby supporting both individual professional growth and the country's broader digital-economy and international-integration objectives.

CONCLUSIONS AND PROSPECTS OF FURTHER RESEARCH

Therefore, developing English language competence is no longer optional for specialists in electronic communications and radio engineering. It is a strategic necessity that directly impacts their ability to access international research, collaborate in global innovation networks, and succeed in the competitive digital economy. European examples, including CLIL, EMI, project- and task-based learning (PBL/TBL), and blended and flipped learning, as implemented at NTNU, Warsaw University of Technology, and in the Austrian-Czech CLIL initiative, demonstrate that integrating language instruction with technical education produces highly effective outcomes, enhancing both professional English skills and domain-specific knowledge.

For Ukrainian higher education, adopting these practices represents a critical opportunity to close the linguistic gap that currently limits students' academic mobility, employability, and international engagement. Embedding English in technical curricula, engaging students in authentic project- and task-based activities, and using digital and flipped learning tools can dramatically improve technical vocabulary, presentation skills, and intercultural competence. Achieving this requires systematic teacher training in CLIL, EMI, and project-based English instruction, robust institutional support for curriculum redesign and English-medium materials, and partnerships with international universities and industry to create authentic English-language learning contexts.

A coordinated, multi-method approach promises measurable and lasting impact: Ukrainian students who master English-mediated professional skills will be equipped to interpret complex technical documentation, deliver reports and presentations in English, and collaborate effectively within global engineering networks. Beyond individual development, these improvements will accelerate the internationalisation of Ukraine's higher education, align training with European engineering standards, and empower graduates to thrive in a rapidly evolving global digital and technological landscape.

Further research could examine the effectiveness of combined CLIL, EMI, PBL/TBL, and blended/flipped approaches and the role of digital tools and international collaboration in enhancing students' English, technical skills, and employability.

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