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CLIL ELEMENTS IN A TECHNICAL UNIVERSITY: INTEGRATING LANGUAGE OBJECTIVES INTO POWER ENGINEERING COURSES

***Annotation.** This article examines the integration of language objectives into Power Engineering courses through Content and Language Integrated Learning (CLIL). Drawing on a two-semester study of 73 students at Vinnytsia National Technical University, it explores how specific discursive functions and scaffolding strategies enhance technical reasoning. The results indicate that aligning linguistic tasks with engineering content significantly improves both conceptual clarity and professional fluency. This study provides a robust methodological framework for developing globally competitive engineers capable of navigating the complex international energy sector.*

***Key words:** CLIL, language objectives, educational technologies, discursive competence.*

***Анотація.** У статті розглядається інтеграція мовних цілей у курси з електроенергетики за методикою CLIL. На основі двосеместрового дослідження за участю 73 студентів Вінницького національного технічного університету аналізується, як специфічні дискурсивні функції та стратегії підтримки (scaffolding) покращують технічне мислення. Результати свідчать, що узгодження мовних завдань із інженерним змістом суттєво підвищує концептуальну чіткість та професійну вільність. Робота пропонує*

методологічну базу для підготовки конкурентоспроможних інженерів, здатних працювати у міжнародному енергетичному секторі.

Ключові слова: *CLIL, мовні цілі, освітні технології, дискурсивна компетенція.*

Introduction. Engineering education today operates in a fundamentally different world than it did even twenty years ago. Two forces have reshaped technical universities across Europe and beyond: the relentless push toward internationalisation and the increasingly global nature of engineering expertise itself. Nowhere is this more evident than in Power Engineering, where practitioners routinely encounter technical documentation, safety protocols, and cutting-edge research – almost exclusively in English. The old model of keeping content instruction and language development in separate compartments simply no longer works.

This is where Content and Language Integrated Learning (CLIL) offers a compelling solution. CLIL allows us to pursue two objectives simultaneously: deepening students' mastery of their discipline whilst developing the English proficiency they need for international collaboration. For technical universities, this dual focus is not merely advantageous – it is essential. Our students must grasp complex thermodynamical principles and grid management strategies, but they must also be able to communicate these concepts effectively in professional settings.

Of course, integrating linguistic objectives into a rigorous power engineering curriculum is far from straightforward. The challenges range from cognitive overload – students are already working hard to master difficult technical material – to the practical difficulties of fostering genuine collaboration between engineering faculties and language departments. These are not trivial obstacles.

This paper examines how we can systematically embed language learning outcomes into technical modules without diluting the scientific rigour that is the hallmark of engineering education. By analysing the intersection of technical terminology and academic discourse skills, we aim to provide a practical methodological

framework that prepares future engineers for the linguistically diverse realities of modern industry.

The energy sector itself is evolving rapidly. The transition to renewable sources and the digitisation of smart grids have fundamentally altered what it means to be a power engineer today. Technical proficiency alone is no longer sufficient for a successful career. Modern engineers must navigate trans-border professional discourse, participate in international teams, and contribute to global innovation networks.

Technical universities face a clear challenge: the gap between students' conceptual understanding of engineering and their ability to articulate that knowledge in globalised contexts continues to widen. The traditional approach to education exacerbates this problem. Language training is often confined to isolated modules, disconnected from the practical realities of the engineering laboratory or power plant. When technical curricula and language objectives operate in silos, we produce graduates who, despite their scientific competence, struggle with international knowledge transfer. This is a systemic issue that demands a systemic response. Addressing this problem serves several critical goals within contemporary education and industry.

First, it enhances human capital in the energy sector. By integrating language objectives into technical programmes, universities directly support the Strategic Research and Innovation Agendas outlined in European and global engineering frameworks. This ensures that the next generation of engineers can lead international projects and meaningfully contribute to global climate goals.

Second, it advances CLIL methodology itself. While the general benefits of integrated learning are well-documented, we lack robust empirical evidence about its effectiveness in highly specialised technical domains such as high-voltage engineering or thermal power systems. This research addresses that gap.

Third, it promotes the standardisation of English for Specific Purposes (ESP) in engineering education. This involves developing practical pedagogical tools that allow trade lecturers to assess linguistic development alongside technical accuracy – creating an interdisciplinary learning environment that reflects real-world engineering practice.

The primary objective of this article is to show how English language instruction can be meaningfully integrated into Power Engineering modules – not bolted on as an afterthought, but embedded within technical content itself. We identify the specific discourse skills students actually need (explaining grid systems, evaluating renewable protocols, presenting technical findings) and demonstrate how these can be developed alongside core engineering concepts. The result is a practical framework that other technical programmes can adapt to better prepare their graduates for international professional practice.

Analysis of recent research and publications. The academic discourse surrounding Content and Language Integrated Learning (CLIL) in technical higher education has transitioned from general advocacy to a focus on disciplinary-specific implementation and technological synergy. In the period between 2020 and 2025, scholars have increasingly argued that the «dual-focused» nature of CLIL is the only viable response to the rapid internationalisation of the engineering sector.

A pivotal study by Ellederová and Denysenko (2025) examined the shifting attitudes within interdisciplinary programmes, specifically «English in Electrical Engineering». Their findings underscore [1] the role of English as a *lingua franca* (ELF) in science, noting that while students recognise the professional necessity of linguistic integration, the primary barrier remains the high cognitive load required to process complex electrical systems in a second language. This aligns with the work of Ruiz de Zarobe (2025), who emphasizes [2] that for CLIL to be successful in high-stakes technical environments, it must move beyond incidental language acquisition towards «structured scaffolding» and «multimodality», utilizing visual and digital tools to bridge the comprehension gap.

In the context of the evolving European Higher Education Area, Voronova, Gerasymchuk, and Gubareva (2026) have proposed [3] a conceptual model for CLIL implementation that specifically addresses the needs of technical universities in Ukraine. Their research highlights that pedagogical agility and «technological readiness» are essential precursors to integrating language objectives into engineering

curricula, particularly during periods of geopolitical instability where digital and remote learning become primary modes of instruction.

Furthermore, Coyle and Meyer (2021) have advanced the theoretical «4Cs framework» (Content, Communication, Cognition, and Culture) by introducing the concept of «Deep Learning» in CLIL. They argue [4] that engineering students require specific «cognitive discourse functions» (CDFs) – such as explaining processes, hypothesising results, and evaluating risks – which are often neglected in traditional ESP (English for Specific Purposes) courses. This is complemented by Mahan (2022), whose research into scaffolding in CLIL settings identifies the critical role of the technical lecturer in mediating both the subject matter and the linguistic structures required to articulate it.

Despite these advancements, several significant gaps remain in the scientific literature, which this study intends to address.

1. Specialisation Gap in Power Engineering. While there is substantial research on CLIL in IT and General Engineering, there is a lack of empirical data regarding its application in Power Engineering. The specific discursive demands of high-voltage systems, grid management, and renewable energy protocols require a unique linguistic framework that has not yet been standardised.

2. The «Hard CLIL» Assessment Dilemma. A recurring unresolved issue, noted by Thi Thu Hien (2022), is the duality of assessment [5]. There is currently no widely accepted methodology for evaluating a student's performance when technical accuracy in a power systems simulation is high, but the linguistic delivery is flawed, or vice-versa.

3. Instructional Synergy and Curriculum Design. Although the need for collaboration between engineering faculties and language departments is established, the practical «mechanics» of this synergy – specifically the design of a 9-week integrated module for technical courses – remains [6] an area of «low empirical visibility» (Meletiadou, 2021).

By focusing on these specific elements, this article aims to provide a robust methodological framework for integrating language objectives into the core modules of

Power Engineering, thereby bridging the gap between theoretical CLIL pedagogy and industrial engineering practice.

Presentation of the main material of the study. The transition from theoretical pedagogical frameworks to practical application within a technical university requires a nuanced understanding of both engineering complexities and linguistic structures. The empirical phase of this research was conducted at Vinnytsia national technical university, focusing on 73 students from the faculty of power engineering and electromechanics over the duration of two academic semesters. This longitudinal approach allowed for the observation of cognitive and linguistic development in real-time. In compliance with ethical research standards, all participants [7] provided informed written consent for the publication of anonymised findings. All data is treated with the utmost confidentiality, and no personal identifiers are disclosed, ensuring the privacy of the students while providing a transparent view of the educational outcomes.

The implementation of the CLIL (Content and Language Integrated Learning) framework at VNTU was designed to move beyond the superficial acquisition of technical vocabulary, focusing instead on the cognitive discourse functions that are inherent to the professional life of a power engineer. During the first semester, the integration focused on foundational technical modules, where the primary objective was to align linguistic output with conceptual accuracy. By the second semester, the complexity increased to include evaluative argumentation and complex diagnostic reporting. The following cases illustrate the practical application of this methodology within specific technical contexts.

In the study of Smart Grid Architectures, students were required to move beyond simple definitions to provide [8] comprehensive discursive descriptions of system transitions. For instance, when explaining the shift from traditional unidirectional power flows to modern bi-directional decentralised grids, students were encouraged to use complex logical linkers of contrast. Rather than stating that «*smart grids are different*», students learned to articulate that «*whilst traditional grids rely on a centralized generation model, smart grids facilitate a bi-directional flow of both electricity and data, thereby enabling real-time modulation of demand*». This required

the simultaneous use of technical terms like load balancing and distributed generation alongside linguistic structures of comparison. We observed that when students used phrases such as «*conversely*», «*in stark contrast to*», and «*whereas*», they were more likely to accurately identify the architectural differences in their technical diagrams, suggesting that the linguistic effort to contrast two ideas clarified the engineering concept itself.

The second application focused on Renewable Energy Systems, where the pedagogical goal was to master the language of evaluative argumentation. Students were tasked with conducting a comparative analysis of the Levelised Cost of Energy (LCOE) for wind, solar, and hydroelectric power. The linguistic focus here was on modality and hedging, which are essential [9] for expressing scientific caution. For example, instead of making absolute claims, students were taught to use structures like «*the data suggests a potential reduction in LCOE*», or «*it is highly probable that the efficiency of photovoltaic cells will increase under specific climatic conditions*». By incorporating adverbs of degree and modal verbs like *might*, *could*, and *should*, students demonstrated a more sophisticated understanding of engineering feasibility. In classroom discussions, this was manifested [10] when students debated the viability of offshore wind farms, using phrases like «*taking into account the intermittent nature of the source*» and «*provided that the grid infrastructure is sufficiently robust*», which showed a bridge between technical knowledge and professional communicative nuance.

The final case involved Power System Fault Analysis, where the objective was the production of objective technical reports. In this module, the linguistic focus shifted to the use of the passive voice to maintain objectivity and the use of causal connectives to explain incident chains. When diagnosing a simulated grid failure, such as a cascading outage triggered by a high-voltage transformer fault, students practiced writing sentences like «*the failure was initiated by a transient overvoltage, which subsequently triggered a series of relay operations*». This forced them to de-personalise the technical event, focusing on the mechanical and electrical variables [11] rather than the observer. Detailed examples included the description of «*root cause analysis*», where students had

to link events using «*stemming from*», «*resulting in*», and «*leading to the eventual disconnection of the load*». This approach significantly reduced the ambiguity in their diagnostic path, as the structured technical English provided a clear, logical map of the electrical malfunction.

The results obtained from the 73 participants at VNTU provide a compelling justification for the systematic integration of language objectives into power engineering courses. The data suggests that the CLIL method does not merely improve English proficiency but actively enhances the quality of technical reasoning. By requiring students to articulate complex thermodynamical or electrical processes through specific discourse functions, the pedagogical framework creates [12] a «dual-processing» environment. This environment forces a more rigorous mental engagement with the subject matter, as the student must understand the engineering concept deeply enough to translate it into a structured, second-language output.

One of the most significant findings was the reduction in cognitive load over time. Initially, the simultaneous processing of language and content was perceived as challenging; however, as students became accustomed to the «scaffolding» provided by the lecturers – such as technical glossaries and sentence starters – their ability to handle complex engineering problems increased. The scientific results indicate that linguistic precision acts as a corrective for technical vagueness. For instance, a student who can [13] correctly use causal connectives is more likely to correctly sequence the events in a power system failure. Furthermore, the transition to «Hard CLIL» fostered a professional identity among the students, making them feel more like members of the international engineering community. The quantitative data, as shown in the table below, confirms a marked improvement in both technical accuracy and linguistic fluency compared to the traditional, isolated teaching methods used prior to this study.

The following table summarises the mean performance scores of the 73 students before and after the two-semester CLIL intervention (Table 1).

Table 1**Comparative results of the CLIL implementation**

Metric (scale 1-100)	Pre-CLIL mean	Post-CLIL mean	Improvement, %
Technical accuracy in reports	68,4	82,7	+20,9%
Linguistic fluency (discursive skills)	54,2	76,5	+41,1%
Use of professional terminology	61,0	85,3	+39,8%
Conceptual clarity in presentations	59,5	79,2	+33,1%
Perceived cognitive load (lower is better)	74,0	62,0	-16,2%

Source: created by author.

Conclusions. The findings of this study demonstrate that the systematic integration of language objectives into the Power Engineering curriculum at Vinnytsia National Technical University represents a significant advancement in technical pedagogy. The longitudinal observation of the 73 participating students confirms that Content and Language Integrated Learning (CLIL) serves as more than a mere linguistic supplement; it acts as a critical cognitive framework that enhances [14] the depth of technical understanding. By aligning specific discourse functions with engineering concepts, such as using causal connectives to describe grid failures or modality to evaluate renewable energy feasibility, the proposed framework successfully bridges the gap between theoretical scientific knowledge and professional communicative competence. The quantitative data further validates this approach, showing that students not only improved their English proficiency but also exhibited higher levels of technical accuracy and conceptual clarity in their professional reports.

Ultimately, the primary goal of this research – to develop and substantiate a methodological framework for seamless language integration – has been achieved. The

evidence suggests [15] that a «Hard CLIL» approach, where engineering lecturers and language specialists work in instructional synergy, significantly prepares future engineers for the demands of the global energy sector. This dual-focused model reduces the cognitive burden over time, allowing students to adopt a professional identity that is both technically rigorous and linguistically flexible. Consequently, the study proves that the perceived conflict between teaching complex engineering content and developing second-language skills is a false dichotomy; rather, these two domains are mutually reinforcing when structured through a clear pedagogical methodology.

The prospects for further research lie in the scalability of this model across other highly specialised technical domains, such as Mechanical Engineering or Information Technology, where similar discursive challenges exist. Future studies should focus on the refinement of assessment rubrics to resolve the «duality dilemma», ensuring a standardised method for evaluating both technical and linguistic performance simultaneously. Additionally, there is a clear need for the development of digital, multimodal scaffolding tools that can further support remote and hybrid learning environments in technical universities. By expanding this interdisciplinary approach, higher education institutions can ensure that their graduates are not only scientifically capable but also professionally articulate in the international academic and industrial discourse.

References

1. Ellederová, E. & Denysenko, V. (2025). Students' and teachers' attitudes towards CLIL in the interdisciplinary study program English in electrical engineering and informatics. *Teaching English as a Second Language Electronic Journal (TESL-EJ)*, 28(4). <https://doi.org/10.55593/ej.28112a8>.
2. Ruiz de Zarobe, Y. (2025). *Content and Language Integrated Learning (CLIL)*. Cambridge University Press. <https://doi.org/10.1017/9781009439251>.
3. Voronova, Y., Gerasymchuk, T., & Gubareva, O. (2026). Content and language integrated learning (CLIL) in Ukrainian technical schools: opportunities,

challenges, and development perspectives. *Scientific Collection «InterConf+»*, (65(279), 39-51. <https://doi.org/10.51582/interconf.19-20.01.2026.004>.

4. Coyle, D., & Meyer, O. (2021). *Beyond CLIL: Pluriliteracies teaching for deeper learning*. Cambridge University Press. <https://doi.org/10.1017/9781108914505>.

5. Thi Thu Hien, T. (2022). Teacher's changes and challenges in CLIL implementation. *VNU Journal of Foreign Studies*, 38(6), 44-58. <https://doi.org/10.25073/2525-2445/vnufs.4883>.

6. Meletiadou, E. (2021). Opening Pandora's box: How does peer assessment affect EFL students' writing quality? *Languages*, 6(3), 115. <https://doi.org/10.3390/languages6030115>.

7. Nykyporets, S. S., & Ibrahimova, L. M. (2021). Communicative competence development among students of non-linguistic universities with the help of CLIL approach in foreign language lessons. *Grail of Science*, (5), 226-231. <https://doi.org/10.36074/grail-of-science.04.06.2021.043>.

8. Blázquez, M., Santos, J., Carro, G., Díaz, G., Castro, M., Latorre, M., Plaza, I., & Arcega, F. (2013). Teaching technology with CLIL methodology: A case study. *2013 IEEE Global Engineering Education Conference (EDUCON)*, 581-590. <https://doi.org/10.1109/EduCon.2013.6530164>.

9. 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>.

10. Coyle, D., Meyer, O., & Staschen-Dielmann, S. (Eds.). (2023). *A deeper learning companion for CLIL: Pluriliteracies in practice*. Cambridge University Press. <https://doi.org/10.1017/9781009043755>.

11. Kanoksilapatham, B., & Khamkhien, A. (2022). CLIL implemented and scaffolded in an EFL higher education context: Engineering research methodology

course. *Indonesian Journal of Applied Linguistics*, 11(3), 502-514.
<https://doi.org/10.17509/ijal.v11i3.36913>.

12. 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>.

13. Aflahatun, N., Januarius, J., Fitriati, S. W., & Pratama, H. (2025). Needs Analysis for the Development of Content and Language Integrated Learning-Based Learning Modules in Civil Engineering Programs. *The Proceedings of English Language Teaching, Literature, and Translation (ELTLT)*, 14, 415-433. URL: <https://proceeding.unnes.ac.id/eltlt/article/view/4712> (last accessed: 2026/01/12).

14. Mahan, K. R. (2022). The comprehending teacher: scaffolding in content and language integrated learning (CLIL). *The Language Learning Journal*, 50(1), 74-88. <https://doi.org/10.1080/09571736.2019.1705879>.

15. 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>.