Students' and Teachers' Attitudes Towards CLIL in the Interdisciplinary Study Program English in Electrical Engineering and Informatics

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Abstract

This study examines the attitudes of teachers and students towards the implementation of content and language integrated learning (CLIL) in the interdisciplinary study program English in Electrical Engineering and Informatics at Brno University of Technology (BUT). It aims to explore the benefits, challenges, and strategies for CLIL in the linguistics and engineering study program. Two questionnaires were administered to 39 students and 15 technical subject teachers, focusing on their language levels, preferences, and experiences in learning and teaching technical subjects in English. Research results revealed positive perceptions among both groups regarding the development of language skills and subject knowledge, underscoring the importance of English as a lingua franca (ELF) in science and technology, enabling professionals from diverse linguistic backgrounds to collaborate and share findings effectively. Students highlighted the need for flexible instructional approaches to accommodate diverse learning preferences, and teachers emphasized the necessity of meticulous planning and consistent practice. Challenges identified included language barriers for both students and teachers, which can impede effective learning and teaching. The study draws attention to the need for heightened awareness of ELF of science and technology, recommending refined instructional approaches and enhanced support mechanisms to overcome language challenges and optimize CLIL implementation in engineering education.

Keywords: CLIL methodology, interdisciplinary study program, questionnaire survey, lesson planning, language through learning

Content and language integrated learning (CLIL) has emerged as a powerful pedagogical approach that combines language and subject matter, fostering a deep understanding of both. CLIL is pivotal in university courses, offering a transformative educational approach that combines language proficiency and subject matter expertise. This integration enhances

students' understanding of complex academic content and equips them with valuable language skills crucial for success in academic and professional settings. Moreover, as Coyle, Hood and Marsh (2010) point out, CLIL has considerable relevance for content teachers as it offers a transformative pedagogical approach that intertwines subject-specific content with language development. It serves as a powerful tool to enhance the effectiveness of their instruction by deepening students' understanding of the academic material and fostering language proficiency in the context of the subject matter. CLIL empowers content teachers to become language facilitators, guiding students through both the complexities of the subject and the nuances of second language acquisition (SLA) (Marsh, 2002; Papaja, 2013). This dual focus not only enriches the learning experience but also equips students with the interdisciplinary skills essential for success in an increasingly interconnected and globalized world (Coyle et al., 2010; Marsh, 2002; Pancheva & Antov, 2017; Vilkancienė, 2011). CLIL involves demanding work from both the teacher and the students, which directly links with a cognitive process where they both think in their native language and express their ideas in the new language.

It is important to differentiate CLIL from English for specific purposes (ESP). While ESP focuses on teaching English tailored to specific fields or professions, emphasizing language skills relevant to particular disciplines (e.g. business, engineering, medicine, law), CLIL integrates the teaching of subject content with language learning, where students learn a subject through a foreign language, thus integrating both content knowledge and language acquisition (Yang, 2016). ESP is primarily concerned with language proficiency specific to professional contexts, whereas CLIL aims to develop both linguistic and cognitive skills through content learning. Yang (2016) argues that both approaches can be seen as points on a continuum, each serving distinct educational goals and sharing similarities in their focus on context and relevance.

University teachers face the challenge of implementing the CLIL approach due to limitations such as insufficient teacher education and inadequate materials (Cinganotto, 2016; Del Pozo, 2015; Del Pozo & Estébanez, 2015; Štefková, Danihelová, Garone, & Kováčiková, 2021), which has led some of them to opt for English-medium instruction (EMI) over CLIL, primarily because EMI originated at the tertiary level in universities, while CLIL is predominantly utilized in primary and secondary schools (e.g. Carrió-Pastor, 2021; Fazzi & Menegale, 2024; San Isidro-Smith & Pérez Cañado, 2024; Tarrayo & Hernandez, 2024). Conversely, certain studies indicate that CLIL offers teachers more opportunities to successfully integrate content subjects in higher education (Corrales, Paba Rey, & Escamilla, 2016; Garone, Van de Craen, & Struyven, 2020). Despite these benefits, teachers express concerns about the lack of proper administrative support, collaborative spaces among lecturers, and language support for both educators and students (Arnó-Macià & Mancho-Barés, 2015; Kim & Lee, 2020). Villabona and Cenoz (2022) suggest that teachers interpret and apply CLIL in diverse manners, resulting in notable distinctions between content-oriented teachers and language-oriented teachers. They argue that achieving a harmonious blend of content and language in CLIL classrooms is challenging due to the tendency of some lessons to be content-oriented, overlooking language aspects, while others are language-oriented, with insufficient attention given to content.

In electrical engineering (EE) and information technology (IT), CLIL offers students a unique opportunity to engage with complex technical concepts while improving their proficiency in the English language, which serves as a lingua franca in science and technology. English as a lingua franca (ELF) promotes inclusivity, allowing scientists from non-English-speaking

countries to participate in the global scientific community (Fane & Wastl, 2023). The rationale for CLIL in EE and IT is twofold. Firstly, professionals in EE and IT domains must collaborate across borders, making English proficiency a critical skill. CLIL facilitates the development of technical vocabulary and communication skills necessary for success in a globalized industry. Secondly, in the face of multidisciplinary complexities, CLIL facilitates a holistic approach by integrating language learning with subject-specific content, encouraging students to perceive the interconnected nature of disciplines ranging from electronics and power systems to computer networks and software development.

Literature Review

Most empirical studies into CLIL at universities published in the last decade focus on either teachers' or students' achievements and attitudes through questionnaire surveys, interviews, observations, and testing. Soulioti's (2014) questionnaire survey at the Epirus Institute of Technology in Greece aimed to explore 60 students' preferences for CLIL instructional strategies to enhance their English proficiency. The study also examined potential reservations about these strategies and investigated students' perceptions and reactions toward the complete implementation of CLIL across the curriculum. Despite acknowledging the benefits of integrating content from various subjects to enhance language and content knowledge, most students expressed a preference for moderate CLIL exposure rather than a fully dual approach or complete CLIL integration throughout the curriculum. The researcher suggests that collaboration between subject and language teachers is essential to determine which subjects are most suitable for English-medium instruction before implementing CLIL extensively in the curriculum. Pancheva and Antov's (2017) research among 40 bachelor's and master's degree students from the Faculty of Forest Industry revealed that CLIL significantly improves cognitive development, cultural awareness, and students' motivation to learn foreign languages, without any detriment to content learning in the subjects where it is used. Responses to open-ended questions varied, with advantages including improved language thinking, better opportunities abroad, challenging lectures, innovative materials, positive attitude development, increased participation, and enhanced professional communication. Challenges revealed the difficulty and time commitment of learning specialized engineering subjects in a foreign language, along with struggles with specialized terminology and understanding concepts. Nguyen, Sercu and Phuong (2023) explored 335 university students' perspectives on CLIL implementation using a survey with closed and open-ended questions, the qualitative analysis highlighted positive views, such as improved English proficiency, a comfortable international learning environment, and high-quality training. Despite the challenges of learning in a non-native language, the findings underscored the rewarding aspects of CLIL education, providing valuable insights for CLIL research in less-equipped university environments. In contrast, Al Zumor's (2019) questionnaire survey of 264 Saudi students in computer science, engineering and medicine indicated that using English negatively impacts students' comprehension and assessment of scientific content, causing anxiety and frustration. Therefore, the study recommends improving English education and considering "additive bilingual education" as an alternative approach.

Satayev et al. (2022) used quasi-experimental research to explore the effectiveness of team teaching enhanced CLIL on 25 biology students' achievement at the University of Kazakhstan. The biology test included multiple-choice questions covering four areas: introduction to digestion, steps in digestion, organs of the digestive system, and digestive secretion. The study

revealed that CLIL had a significant positive impact on student achievement in both biology subject knowledge and English language proficiency, emphasizing the crucial role of CLIL.

According to Phan's (2021) study conducted at Ni Anh University of Technology Education (NAUTE), teachers lacked a solid understanding of CLIL, leading to inconsistent conceptualization throughout the lessons. Despite experience in English teaching, they struggled with CLIL due to a lack of pedagogical knowledge, finding integrated language and subject teaching confusing. These challenges were compounded by the absence of training and theoretical frameworks, highlighting the need for better preparation in the CLIL environment at NAUTE. Similarly, Štefková et al. (2021) focused on CLIL implementation at the Technical University in Zvolen, Slovakia, with a specific emphasis on the CLIL teacher profile and university teachers' readiness for CLIL integration. The research, driven by the growing significance of English for professional, academic, and scientific purposes, adopts a qualitative approach using SWOT analysis to assess teacher preparedness. Fifteen university teachers were interviewed, revealing shortcomings in language and methodological readiness. Despite this, teachers expressed a willingness to enhance their skills for a CLIL methodology, recognizing its language importance. However, the study identified a potential threat in students' insufficient language proficiency, which could deter their participation in CLIL-inclusive lectures and seminars.

Very few empirical studies have dealt with both teachers' and students' views on CLIL at universities. In Alblooshi's (2017) qualitative cross-sectional research within the United Arab Emirates universities, 10 teachers' and 20 students' opinions were examined using interviews, focus groups, observations, and document analysis. The study, focusing on classroom behaviour and practice, aimed to understand how teachers' beliefs and epistemologies impact attitudes and motivation towards CLIL implementation. Results showed that most teachers were underprepared and underqualified for CLIL instruction. The author of the study emphasizes the importance of fostering motivation in CLIL learning, which reduces the teachers' effort, as students with positive attitudes are more attentive and driven to accomplish more in the classroom. Garone et al. (2020) explored the interests, perceptions, and expectations of nursing students and teachers regarding multilingual nursing education. Their investigation involved a student questionnaire survey and teacher interviews conducted at two Dutch-speaking higher education institutes in Brussels. The findings revealed that students favoured distinct language skills courses over integrated content and language courses. While teachers generally expressed positivity towards the concept of integrated multilingual nursing education, they anticipated the need for more time allocation and linguistic support from experts to seamlessly integrate foreign languages into the curriculum. Additionally, the teachers emphasized the importance of establishing clear objectives for students. The study concludes that the successful implementation of multilingual integration in nursing education hinges on policies that provide proper support for teachers and articulate learning objectives for students.

The studies presented above indicate the existence of a research gap focusing on the comparison of university teachers' and students' attitudes towards implementing CLIL in EE and IT subjects. Moreover, none of the studies dealt with CLIL implementation in the study program that combines linguistics and engineering. Thus, this study aims to explore and discuss the benefits, challenges, and strategies for implementing CLIL in the bachelor's study program English in Electrical Engineering and Informatics at Brno University of Technology (BUT).

The following research questions were defined:

1) What are the advantages and limitations of implementing CLIL in EE and IT subjects according to students who attend the technical subjects taught in English?

2) What are the advantages and limitations of implementing CLIL in EE and IT subjects according to technical subject teachers?

3) How can teaching and learning EE and IT subjects in English be improved?

Context and Method

The CLIL research was conducted among technical subject teachers and students of the bachelor's study program English in Electrical Engineering and Informatics at the Faculty of Electrical Engineering and Communication of BUT in the Czech Republic. This interdisciplinary study program aims to equip the students with fundamental knowledge of EE and IT and especially with the competencies in professional language at level C1 of the *Common European Framework of Reference for Languages* (CEFR). While technical subjects are taught in Czech to some extent, they should predominantly adhere to a CLIL methodology. Besides technical subjects and ESP (English for Engineers, English for IT, Business English), the program includes linguistically oriented subjects, e.g. Language as Discourse in Science and Technology, Scientific Style in Czech and English, Contrastive Analysis of Scientific Texts, Pragmatics, Discourse Analysis and Translation Studies. The graduates should master the interdisciplinary knowledge and skills necessary considering the position of ELF in the highly developing and expanding fields of EE and IT in the present globalising world. They will be prepared to occupy positions of technical writers and communicators, translators and interpreters, assistants, or managers in multinational scientific and technological companies.

Two questionnaires (see Appendix) were designed to elicit answers from technical subject teachers and students who agreed to participate in the survey. The questionnaires for teachers and students differ to address the distinct roles, perspectives, and experiences of these two groups. The teacher questionnaire focuses on instructional methods, preparation and assessment, and experience with CLIL, while the student questionnaire asks about learning experiences, preferences, and outcomes in the CLIL context. By addressing these different aspects, the questionnaires can gather comprehensive data that reflects both the teaching and learning experiences in the CLIL environment. This approach ensures that both sides of the educational process are understood and can be optimized for better outcomes. A total of 39 students and 15 teachers of EE and IT subjects participated in the questionnaire survey at the end of the summer semester of 2023 after students completed all the ESP and linguistically oriented subjects and fifteen technical subjects taught in English. An online survey system, Survio, was used for data collection and statistical analysis. The reliability of the questionnaires was verified through their piloting among ten students and three teachers of technical subjects. Cronbach's alpha coefficient reached 0.83% for the teacher questionnaire and 0.85% for the student questionnaire. According to Kline (2000), these results indicate a relatively high level of internal consistency for the questionnaires.

Results

The quantitative research results focus on the comparison of students' and teachers' answers to the same questions to obtain a better insight into their opinions, students' responses to closed

questions, and teachers' responses to closed questions. Moreover, examples of students' and teachers' answers to open questions are provided and discussed.

As shown in Table 1, 88% of students had a certificate in the English language. Most students had a state maturita school leaving exam in the English language (28.00%), a bachelor's degree in the English language (24.00%) and a Cambridge English certificate (26.00%). One student earned a master's degree in English at Masaryk University in Brno before applying for the study program English in Electrical Engineering and Informatics at the Faculty of Electrical Engineering and Communication of BUT. The other certificates (8.00%) that students obtained were two Cambridge English: Business Vantage certificates and two IELTS Band 6 certificates. Most teachers (75.00%) did not have a certificate in English, which was surprising considering they teach technical subjects in English. Only one teacher had a doctoral degree (6.25%), and one had a state maturita exam in English (6.25%). Furthermore, one teacher (6.25%) had a Cambridge English certificate: Preliminary and one teacher (6.25%) had a STANAG 6001 Level 2 certificate. Overall, it was unexpected to find such a low percentage of English language-certified teachers. On the other hand, all teachers had a Ph.D. degree in electrical engineering.

Table 1. Students' and teachers' certificates in the English language

	Students		Teachers	
Answer	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency
State maturita in English	14	28.00%	1	6.25%
Bachelor's degree in English	12	24.00%	0	0.00%
Master's degree in English	1	2.00%	0	0.00%
Doctoral degree in English	0	0.00%	1	6.25%
Cambridge English: Preliminary	1	2.00%	1	6.25%
Cambridge English: First	6	12.00%	0	0.00%
Cambridge English: Advanced	4	8.00%	0	0.00%
Cambridge English: Proficiency	2	4.00%	0	0.00%
Other	4	8.00%	1	6.25%
I do not have one	6	12.00%	12	75.00%
Total	50	100.00%	16	100.00%

Table 2 illustrates that more than half of the students (almost 58%) and most teachers (88.24%) believed that learning a technical subject in English helped develop both language skills and subject knowledge. Some students (18.42%) also stressed the importance of improving subject knowledge. Only 10.53% of students responded that learning a technical subject in English developed neither language skills nor subject knowledge.

Table 2. Students' and teachers' opinions of what learning a technical subject in English helps develop

Answer	Students		Teachers	
	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency
Language skill	4	10.53%	1	5.88%
Subject knowledge	7	18.42%	1	5.88%
Both language skills and subject knowledge	22	57.89%	15	88.24%
Neither language skills nor subject knowledge	4	10.53%	0	0.00%
Other	1	2.63%	0	0.00%
Total	38	100.00%	17	100.00%

Half of the teachers spoke only English during a lesson, while 22.73% of students chose to speak only English during lessons (Table 3). Most students (56.82%) still used 30% of the Czech language in technical subject lessons. The inclination of both students and teachers towards English as the primary language, with minimal use of Czech, is an encouraging indication.

Table 3. Students' and teachers' language in technical subject lessons

Answer	Students		Teachers	
	Absolute frequency	Relative frequency	Absolute frequency	Relative frequency
Only English	10	22.73%	8	50.00%
About 70% English, 30% Czech	25	56.82%	3	18.75%
About 50% English, 50% Czech	8	18.15%	3	18.75%
About 30% English, 70% Czech	1	2.30%	2	12.50%
Total	44	100.00%	16	100.00%

Table 4 illustrates that 44.83% of students thought more time should be spent on speaking English, while only 24.14% believed they should focus on listening. A slightly surprising fact is that only 17.24% chose reading, and 13.79% selected writing, even though writing skills are as crucial as speaking skills in the study program English in Electrical Engineering and Informatics.

Table 4. Activities required by students in technical subject lessons in English

Answer	Absolute frequency	Relative frequency
Speaking in English	26	44.83%
Reading in English	10	17.24%
Listening in English	14	24.14%
Writing in English	8	13.79%
Total	58	100%

According to Table 5, it is evident that a considerable number of students (38.33%) believe that it is essential to focus on mastering technical vocabulary, which highlights the significance of equipping students with a specialized set of words related to technical fields that can aid in

accurately expressing and comprehending complex ideas. Closely following, 35.00% of students preferred an instructional emphasis on group projects and discussions, highlighting the pivotal role of collaborative activities in enhancing their understanding of technical subjects. This perspective aligns with the notion that real-world application and shared exploration significantly contribute to a comprehensive learning experience. In contrast, only 15.00% of students prioritized traditional instructional approaches, asserting that the teachers' direct instruction should be a primary focus in teaching technical subjects in English and highlighting their preference for structured and authoritative information.

Table 5. The main focus of technical subject lessons according to students

Answer	Absolute frequency	Relative frequency
Technical terminology	23	38.33%
A teacher lecturing	9	15.00%
Group projects and discussions	21	35.00%
Other	7	11.67%
Total	60	100.00%

Table 6 indicates that 40% of teachers recognized the need to improve their English proficiency, and 46.67% admitted that they might benefit from some training, while only 13.33% believed their English skills were sufficient. This acknowledgement of language shortcomings aligns with students' concerns about comprehension issues with technical subject teachers instructing in English.

Table 6. Teachers' needs for improvement in the English language

Answer	Absolute frequency	Relative frequency
Yes (I need to improve it)	6	40.00%
No (I do not need to)	2	13.33%
I might benefit from some training	7	46.67%
Total	15	100.00%

Most teachers (73.33%) indicated that planning and teaching a technical subject in English necessitated more time compared to teaching the subject in the native language (Table 7). Another 20.00% of teachers expressed that it required an equivalent amount of time, while a mere 6.67% believed that teaching in English demanded less time.

Table 7. Teachers' time spent on lesson planning and teaching a technical subject in English

Answer	Absolute frequency	Relative frequency
More time than teaching the subject in the native language	11	73.33%
Less time than teaching the subject in the native language	1	6.67%
The same time as teaching the subject in the native language	3	20.00%
Total	15	100.00%

A considerable number of teachers (73.3%) perceived the methodology for teaching a technical subject in English as identical to that employed when teaching in Czech (Table 8), which indicates a prevailing tendency among teachers to maintain consistency in their instructional approach across languages. On the contrary, 26.67% of teachers acknowledged adopting a

distinct methodology when teaching technical subjects in English. Several factors may contribute to this deviation, including the need to address language-specific challenges, accommodate diverse learning styles, or leverage specialized pedagogical techniques that enhance comprehension in an English-language instructional setting. This divergence in teaching methods underscores the nuanced considerations that educators navigate when delivering technical content in a language other than their students' native tongue.

Table 8. Teachers' methodology of teaching a technical subject in English

Answer	Absolute frequency	Relative frequency
Different methodology than a technical subject teaching	4	26.67%
The same methodology as a technical subject teaching	11	73.33%
Total	15	100.00%

The next part of the article will focus on the responses of students (transcribed verbatim) and teachers to open questions. The purpose is to analyse their statements and discuss the advantages and potential drawbacks of implementing CLIL in technical subjects in the study program English in Electrical Engineering and Informatics. Since many respondents' answers to open questions were similar, only illustrative examples are provided below. The responses are grouped according to the topic the open questions in the questionnaire asked about, i.e. benefits and drawbacks of studying and teaching technical subjects in English, the language of learning materials, preference of the written or oral examination, and the recommendations on how to improve teaching methods and approaches.

Students' Answers to Open Questions

Students' responses to open questions revealed a prevailing consensus among the majority. Specifically, they shared the belief that studying a technical subject in English enhances the acquisition of technical terminology, fosters the development of academic writing and speaking skills, and facilitates exploration of various sources available in the English language (see Examples 1–3).

(1) *Learning scientific terminology in English gives you a wider understanding of a subject and a much bigger leeway for potential self-study.*

(2) *Vocabulary, academic English including grammar features and style of writing, presentation skills (use of specific language to talk about narrowly targeted phenomena).*

(3) *Gives you a better overview of the topic and makes it easier to find other study material.*

Besides, students also emphasized the importance of learning technical subjects in ELF of science and technology (see Example 4).

(4) *Improving your English is also a generally good thing to do in a field that is English-dominated.*

On the other hand, as Examples 5–8 illustrate, the students' responses highlighted concerns about learning a technical subject in English, citing challenges such as a language barrier, difficulty in understanding due to insufficient vocabulary, potential struggles with teachers' proficiency in English, and limitations in understanding complex topics.

(5) *Sometimes you are not familiar with the terms.*

(6) *It may be harder or take longer to understand concepts compared to learning them in your main language. You may not know a critical word or phrase, and taking time to look it up diverts your attention and may make it hard to follow the rest of the conversation/lecture.*

(7) *Teachers have difficulty finding the right terms (or words for describing how different devices function).*

(8) *... Furthermore, the level of actual technical knowledge learned highly depends on the English level of the lecturer and their ability to express and transfer their knowledge in English.*

The students' responses indicate various preferences regarding learning from diverse English technical texts. Some preferred learning solely from English sources to enhance language proficiency and prepare for industry environments (Example 9). Others emphasized the importance of bilingual education, finding such lectures more interesting, valued the inclusion of Czech equivalents for better comprehension and advocated for a combination of English and native language materials, citing the need for a well-rounded understanding and the significance of knowing technical terms in both languages for effective communication, especially in a professional context (Examples 10, 11 and 12). Nevertheless, some students argued against exclusive reliance on English materials due to potential language barriers or the complexity of technical subjects (Example 13).

(9) *Yes, I think it's important to take the opportunity to learn English you will need before you get into an industry environment. At this stage of your education, your English should be proficient enough to understand the course material.*

(10) *No, it is better to have both English and our native language coursebooks so we can compare translations and understand them properly.*

(11) *I like to combine English material with Czech material as it is still important to me to be proficient in my field in my native language.*

(12) *Sometimes it's useful to have a Czech equivalent – for example in labs, the exercise materials were available in both languages, which was great.*

(13) *No, sometimes it is good for understanding the basic principles to learn the subject matter from technical books in the native language and afterwards learn the vocabulary in English technical books, because some things could be lost in translation. Many students, who learned only from English technical books, did not understand what the subject was about.*

Most students preferred to take both written and oral exams. Examples 14 and 15 suggest that this form of testing seems the most effective, as it makes students properly understand a subject across various aspects.

(14) *Both. Some topics can be better described by oral means. However, this is highly individual, and some subjects are less suitable for oral exams (e.g. Maths).*

(15) *Both. They both test understanding of the subject as well as the ability to be understood in the area of expertise. The majority of teamwork is done by speaking*

to other team members or others, while writing is useful for reports and such. So, both skills are necessary.

Students shared their opinions on the advantages of learning a technical subject in English. Overall, learning a technical subject in English offers significant benefits, including enhancing students' employability in international companies, potentially leading to higher salaries; facilitating faster and more extensive study opportunities due to the abundance of English-language resources; and fostering bilingual proficiency in both academic and professional contexts, as demonstrated in Examples 16–18.

(16)　*With the presence of English as a lingua franca in many technical fields, it is easy to find additional materials I can use for my studies.*

(17)　*Learning technical subjects in English is extremely valuable on the job market, as being able to work in multi-cultural environments (where English is used on a daily basis) can help you stand out on the job market immensely.*

(18)　*Getting fluent in the lingo during your studies, so you can immediately utilize it when you start working in a relevant field.*

(19)　*The biggest advantage is the opportunity of using/applying/sharing that knowledge internationally. It is easier to find jobs as many now require some level of international cooperation and it is also easier to search for any additional data/information.*

Students identified several challenges in learning a technical subject in English, pointing out the language barrier, especially when dealing with complex technical terms. Issues included a lack of English proficiency among students and teachers, leading to potential difficulties in understanding and effective communication, as Examples 20–22 illustrate. Teaching and learning complex concepts and issues seem difficult for teachers and students whose English level is low; therefore, students and teachers who learn and teach a subject in English should have a good command of English.

(20)　*If people are behind in their English, they will fall even further behind in their studies and have significant issues completing their courses.*

(21)　*Low level of English of some teachers, "Czenglish" in terminology. (which can cause some major misunderstandings).*

(22)　*Teachers – in my opinion their level of English was very low.*

As Examples 23 and 24 show, discrepancies in terminology between Czech and English, coupled with the challenge of grasping intricate concepts in English, might contribute to the perceived complexity of learning technical subjects in English.

(23)　*Sometimes the difference between technical terminology in English and Czech is very specific and requires to be memorized on top of the sole learning material. This may lead to some confusion / more time-consuming learning curve.*

(24)　*Phenomena that would be hard to be explained in Czech are even more difficult to understand when explained in a foreign language.*

Students should provide suggestions on improving lessons in technical subjects taught in English. As Examples 25 and 26 indicate, most students observed that teachers failed to

properly present information in English due to incorrect pronunciation and limited vocabulary. Students again advocated for the availability of textbooks in either English or bilingual formats (English and Czech), underlining the importance of aligning learning materials with the language of examination. The adoption of English-language learning resources is posited to facilitate improved accessibility, streamlining both preparation and study endeavours for students mandated to take exams in English.

(25) *Ensure that the instructors themselves are good at English, have an easily understandable accent and can spell every important word correctly to alleviate confusion.*

(26) *By using more English in the lessons or by training some of the teachers to improve their English. Maybe also by translating the textbooks to English, because it is confusing and difficult to prepare for an English exam for an English subject using a textbook in Czech.*

Students appreciated their favourite technical subjects taught in English for various reasons, including comprehensive explanations by teachers, the practical and attractive nature of the subject matter, a balance between English language proficiency and technical depth, and engaging and interactive teaching methods. Additionally, subjects with clear structures, excellent presentation skills from lecturers, and a focus on both terminology and technical aspects were well-received. Enthusiastic teachers, engaging practical applications, and the opportunity to use knowledge in group projects were the other reasons for liking specific subjects.

Teachers' Answers to Open Questions

Teachers' answers revealed their different teaching experiences teaching a technical subject in English. Table 9 demonstrates that teachers had varying levels of experience, ranging from two to thirty years, and most of them taught one or two technical subjects in English. A few teachers taught three subjects in English, and only one respondent taught five to ten subjects using a CLIL methodology.

Table 9. The length of teaching experience and the number of subjects taught in English through CLIL

Teacher	Teaching experience (Yrs)	Subjects taught in English	Teacher	Teaching experience (Yrs)	Subjects taught in English
Teacher 1	20	3	Teacher 9	2	1
Teacher 2	6	1	Teacher 10	7-8	2
Teacher 3	15	3	Teacher 11	7	3
Teacher 4	5	1	Teacher 12	8	5~10
Teacher 5	5	2	Teacher 13	~30	2
Teacher 6	5	2	Teacher 14	2	1
Teacher 7	20	3	Teacher 15	3	2
Teacher 8	3	2			

As Examples 27, 28 and 29 show, teachers believe that when technical subjects are taught in English, students can acquire more information than in their native language due to the widespread use of internationally recognized terms in EE and IT. Teachers asserted that English is considered a lingua franca in technical areas, and the most valuable information,

especially in IT, is available in English through books, online blogs, and video science communicators. Therefore, English proficiency is essential for work in international companies, and learning phrases, idioms and expressions in their field allows students to think differently, discover new relationships, and access a wealth of materials available in English and various online sources.

(27) *Widely/internationally used terms related to a specific subject are used. The English is more common in a technical field.*

(28) *They think differently, reveal new relationships.*

(29) *I see the main benefit in the fact that it is much easier to find out more information using English phrases. These are almost exclusively available in English in our area of interest.*

Teachers identified several reasons why students may learn less information in technical subjects taught in English. Challenges include the difficulty of understanding particular topics in a foreign language, the increased time demand for comprehension, and the potential discrepancy between English understanding and the native mindset (Examples 30–33). Additionally, insufficient English proficiency, the need for more time for explanations due to language barriers, and the unavailability of some materials in English contribute to the perceived limitation in learning. Finally, students' discomfort when speaking English, challenges in understanding technical principles and limited English proficiency further impact the learning process.

(30) *It is harder to understand technical principles when a foreign language is used. Descriptions of some circuit principles are complicated to understand, even in the native language.*

(31) *Understanding some themes can be more difficult in a foreign language and is more time demanding.*

(32) *Sometimes it is necessary to dedicate more time to the explanation because besides technical misunderstanding also the language problems can occur.*

(33) *They cannot map 1:1 their English understanding with their native mindset. I believe this can pretty much be ignored in practice, but I see a different way of communicating technical subjects among Spanish colleagues at work than when they do in English.*

Most teachers used learning materials in English (Example 34), but some of them implemented the text in Czech to explain the topic more clearly and in greater detail (Example 35).

(34) *Yes. Mainly because the information is in English as well as being more clear not mixing up languages.*

(35) *Basic materials are in English. However, students have the option of working with their Czech equivalents.*

Most teachers preferred evaluating students through written assessments rather than oral ones. This inclination is primarily rooted in the belief that writing demands a thorough understanding and adept orientation within the subject matter (Example 36). The written format was perceived as a robust means to ensure fair grading, allowing students to demonstrate their comprehension

and application of technical concepts. While written assessments prevailed, some teachers contemplated incorporating oral exams, often as project defences where students verbally articulate their work and rationale (Examples 37 and 38). The decision to favour written assessments is also influenced by their efficiency, with the process being quicker and conducive to meeting time constraints. Students typically undertake semester projects, presenting their findings in English, culminating in a written exam assessing their proficiency in the technical subject.

(36)   *Writing requires good knowledge and orientation in the subject.*

(37)   *Written. The exam includes exercises and also the theoretical questions combining both languages (or translation of the terms). However, I consider the oral exam in the future.*

(38)   *Written, oral project defense to prove they can explain what they have done and why.*

When preparing materials for teaching a technical subject in English, most teachers claimed that clarity, comprehensibility, and accurate and consistent terminology were essential. Another frequent answer involved both the technical aspects of the subject and the English language, as Example 39 shows.

(39)   *To be precise from both technical and language point of view and to provide always the most actual information.*

Teachers were asked what is the most beneficial for the students who learn a technical subject in English. As expected, most teachers mentioned the advantages of acquiring specialized terminology in English and a better understanding of the subject content in ELF of science and technology (Examples 40 and 41). Teachers also highlighted that it is highly beneficial to learn a technical subject in English since not only will the students become more proficient in English, but it will also allow them to find a well-paid job in multinational companies worldwide.

(40)   *They learn technical problems and English at the same time. They learn the vocabulary from the given branch of the study and after that it is easier for them to read technical papers which are mostly in English.*

(41)   *All datasheets and technical information are in English, if they learn technical subject in English, they can handle all information much more effectively.*

The last question was about the least beneficial factor when students learn a technical subject in English. As Examples 42–44 indicate, most of the answers were similar. The English language might present some limitations for students, e.g., not understanding all the concepts correctly or missing important information. Besides, mastering a complex topic in a foreign language presents challenges and demands a significant investment of time, necessitating patience and consistent practice.

(42)   *If their level of English is low, they do not learn the technical content.*

(43)   *Understanding of the complex issue can be more difficult for the students.*

(44)   *Mastering a subject in both languages takes more time.*

Discussion

The findings from the research into CLIL in EE and IT subjects reveal interesting insights into both students' and teachers' language awareness. Most students and teachers agreed that learning a technical subject in English contributes positively to developing both language skills and subject knowledge. In terms of focus areas for technical subjects, students varied in their opinions, either emphasizing technical terminology or endorsing group projects and discussions. These diverse perspectives suggest a need for flexibility in instructional approaches to cater to different learning preferences in CLIL lessons (cf. Coyle et al., 2010).

The results also reflect a perceived need for improvement among teachers, acknowledging the necessity of enhancing their English skills and expressing a desire for training, indicating an openness to professional development (cf. Kim & Graham, 2022). Concerning time commitment, most teachers believed planning and teaching a technical subject in English required more time than doing so in the native language. Effective implementation of CLIL necessitates meticulous methodological planning (e.g. Carloni, 2013; Kim & Graham, 2022; Meyer, 2010; Štefková et al., 2021). This imperative should be communicated to technical subject teachers to ensure that the quality of teaching and learning aligns with expectations.

A notable observation is a recurring theme in open-ended answers where students expressed similar views on the benefits of acquiring technical terminology and developing academic writing and speaking skills. Many students emphasized the ease of accessing information in English, considering it advantageous in a field where English serves as a lingua franca of science and technology. However, an interesting contrast emerged, with some students expressing concerns that they might learn less information compared to studying in their native language. Regarding learning materials, students presented diverse opinions on the preference for using English technical books exclusively. While one group emphasized the importance of teacher interaction and explanations in their native language, the other group saw benefits in learning from English technical books, particularly for career opportunities in foreign countries. This underscores the importance of a balanced approach to learning materials in the context of the study program English in Electrical Engineering and Informatics. Furthermore, teachers highlighted the importance of clarity, comprehensibility, and precise and consistent terminology when preparing materials for English-medium instruction, emphasizing the critical role these factors play in effective teaching.

In addressing the broader implications of learning technical subjects in English, students identified key advantages, including enhanced employability in foreign companies, quicker access to information on the Internet, and the acquisition of English terminology. Consistent with expectations, teachers also emphasized the benefits of students acquiring specialized terminology in English and gaining a comprehensive understanding of the subject content in both Czech and English. The prospect of students achieving greater proficiency in English and enhancing their employability in multinational companies was also prominently mentioned (cf. Corrales et al., 2016; Pancheva & Antov, 2017). These findings align with the broader goals of CLIL (e.g. Marsh, 2002; Coyle et al., 2010) emphasizing language proficiency alongside subject knowledge acquisition.

However, challenges were also identified, particularly concerning the language barrier and the English proficiency levels of both students and teachers. A lack of teachers' linguistic competence in subject-specific vocabulary knowledge and pronunciation issues were also

observed by Pérez Cañado (2016), Yildiz (2019) and Durán-Martínez, Beltrán-Llavador (2020), and Metlí and Akıs (2022). In their efforts to enhance the study program, students provided constructive feedback, highlighting the need to improve teachers' pronunciation and vocabulary. Additionally, students recommended a more structured approach to lessons as a means of fostering a conducive learning environment. These recommendations underscore the students' commitment to an enriched educational experience and a desire for refined language instruction within a well-organized framework.

Teachers recognized the demanding nature of mastering complex topics in a non-native language, emphasizing the necessity for patience and consistent practice. This insight into the perceived drawbacks provides valuable considerations for refining instructional approaches and support mechanisms to address the challenges students may encounter when studying technical subjects in the study program English in Electrical Engineering and Informatics.

Conclusion and Pedagogical Implications

The research findings are not only relevant within the local context, but they also have significant international implications, reflecting trends and challenges in CLIL implementation in technical courses at the tertiary level globally. The growing demand for CLIL across various engineering fields is particularly strong in European contexts, where initiatives such as Erasmus+ have promoted CLIL adoption in higher education. The successful implementation of CLIL requires substantial methodological refinement and targeted teacher training. Key challenges include ensuring that teachers possess sufficient linguistic competence, understand CLIL-specific pedagogy, and are trained in both content and language instruction (cf. Pérez Cañado, 2018; Metlí & Akıs, 2022).

The investigation of CLIL in the context of interdisciplinary learning, as presented through students' and teachers' perspectives, revealed both advantages and challenges. To optimize the learning experience, the authors of the study suggest integrating the following approaches to teaching a technical subject through CLIL.

Balanced Focus on Language and Content

Given the diverse opinions on focus areas – some students emphasize technical terminology while others prefer group projects and discussions – teachers should adopt flexible instructional approaches. This flexibility can accommodate various learning preferences, ensuring that all students benefit from CLIL lessons. For instance, integrating both vocabulary exercises and collaborative activities can address different needs simultaneously (Coyle et al., 2010). Technical subject teachers should also deliberately incorporate language development into their subjects through targeted language activities, such as terminology quizzes, technical writing assignments, and oral presentations, to enhance both subject knowledge and language proficiency. Emphasizing language alongside content ensures students gain the necessary skills to access and communicate complex technical information effectively.

Teacher Professional Development

The need for improved English skills among teachers indicates the importance of ongoing professional development. Training programs should focus on enhancing teachers' linguistic competence with an emphasis on subject-specific vocabulary, accuracy and fluency. Professional development can also include strategies for effective CLIL instruction, such as scaffolding techniques and the use of visual aids to support comprehension (e.g. Kim & Lee,

2020; Meyer, 2010). Since teachers reported that teaching technical subjects in English requires more time for planning and instruction, educational institutions should recognize this demand and provide adequate time and resources for teachers to prepare, including access to CLIL-specific teaching materials and planning tools that help integrate language and content effectively (Carloni, 2013; Štefková et al., 2021).

Learning Material Selection and Use

The differing preferences for learning materials – some students prefer native language explanations, while others favour English technical books – highlight the need for a balanced approach. Teachers should consider using bilingual materials or providing supplementary explanations in the native language to ensure all students can access and understand the content. This approach can help bridge the gap between language proficiency levels and technical understanding. Moreover, teachers should provide students with glossaries of key terms and ensure that explanations are clear, and terminology is reinforced consistently to facilitate better understanding and retention of both language and content.

Student-Centred Feedback and Improvement

Students' feedback on the need for structured lessons suggests that a well-organized instructional framework is crucial. Teachers should plan lessons that follow a logical sequence, integrating language and content goals. Structured lessons help students follow complex topics more easily and provide a clear path for language and content development. Constructive feedback from students on teachers' pronunciation and vocabulary underscores the importance of linguistic accuracy in CLIL. Teachers should seek continuous improvement in these areas, perhaps through language workshops or peer review sessions. Accurate pronunciation and precise vocabulary use not only improve communication but also model proper language use for students.

In conclusion, the successful implementation of CLIL in technical university courses requires a multifaceted approach that balances content and language, provides ongoing professional development for teachers, and uses adaptable learning materials. By focusing on both subject matter and language proficiency, fostering teacher skills, and responding to student needs for structured lessons and clear communication, institutions can optimize CLIL's potential. This holistic strategy will ensure that students are well-prepared to succeed in technical fields while developing the language skills necessary for success in global academic and professional environments. Therefore, further research is essential to continuously refine and enhance CLIL methodologies, particularly within the unique context of technical universities. Investigating the long-term effects of CLIL on students' academic performance and language acquisition, as well as identifying the most effective strategies for integrating specialized technical content, will be crucial for maximizing its impact and ensuring its adaptability to evolving educational and industry needs.

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Appendix

CLIL Questionnaire for English for Electrical Engineering and Informatics Students

1) Do you have a certificate in the English language?

A) No

B) Yes (Please, tick one or more options below.)

a) State maturita in English

b) Bachelor's degree in   English

c) Master's degree in English

d) Doctoral degree in English

e) Cambridge English: Preliminary

f) Cambridge English: First

g) Cambridge English: Advanced

h) Cambridge English: Proficiency

i) Other(s) (specify which):

………………………………………………………………………………………………..

2) Learning a technical subject in English helps you to develop

A) language skills

B) subject knowledge

C) both language skills and subject knowledge

D) neither language skills nor subject knowledge

E) other (specify)

………………………………………………………………………………………………..

3) When a technical subject is taught in English, you can learn

A) more information than in your native language because

………………………………………………………………………………………………..

B) less information than in your native language because

………………………………………………………………………………………………..

4) In technical subject lessons you

A) speak only English

B) speak about 70 % of the lesson time English and 30 % Czech

C) speak about 50 % of the lesson time English and 50 % Czech

D) speak about 30 % of the lesson time English and 70 % Czech

5) In technical subject lessons, you would like to spend more time

A) speaking in English

B) reading in English

C) listening in English

D) writing in English

6) Technical subject lessons should mainly focus on

A) technical terminology

B) a teacher lecturing

C) group projects and discussions

Other (specify): ……………………………………………………………………………

7) Would you like to learn only from English technical books, coursebooks and other texts in technical subjects you attend?

A) Yes

Give reasons why:

………………………………………………………………………………………………..

B) No

Give reasons why:

………………………………………………………………………………………………..

8) What type of exam would you prefer to take in your technical subjects in English?

A) written exam

Give reasons why:

………………………………………………………………………………………………..

B) oral exam

Give reasons why:

………………………………………………………………………………………………..

C) both written and oral exam

Give reasons why:

………………………………………………………………………………………………..

9) What is the biggest advantage in learning a technical subject in English and why?

………………………………………………………………………………………………..

………………………………………………………………………………………………..

………………………………………………………………………………………………..

10) What do consider the biggest problem in learning a technical subject in English and why?

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……………………………………………………………………………………………………..

……………………………………………………………………………………………………..

11) How could lessons in technical subjects in English be improved?

……………………………………………………………………………………………………..

……………………………………………………………………………………………………..

……………………………………………………………………………………………………..

12) What technical subject in English did you like best and why?

……………………………………………………………………………………………………..

……………………………………………………………………………………………………..

……………………………………………………………………………………………………..

CLIL Questionnaire for Technical Subject Teachers

1) Do you have a certificate in the English language?

A) No

B) Yes (Please, tick one or more options below.)

a) State maturita in English

b) Bachelor's degree in English

c) Master's degree in English

d) Doctoral degree in English

e) Cambridge English: Preliminary

f) Cambridge English: First

g) Cambridge English: Advanced

h) Cambridge English: Proficiency

i) Other(s) (specify which):

……………………………………………………………………………………………………..

2) How long have you been teaching through content and language learning (CLIL), i.e. teaching a technical subject in English?

……………………………………………………………………………………………………..

3) How many technical subjects do you teach in English?

…………………………………………………………………………………………..

4) Do you think your English language skills need improvement to teach a technical subject in English?

A) Yes

B) I might benefit from some training.

C) No

5) Lesson planning and teaching a technical subject in English requires

A) more time than teaching the subject in the native language

B) less time than teaching the subject in the native language

C) the same time as teaching the subject in the native language

6) Teaching a technical subject in English requires

A) a different methodology than a technical subject teaching

B) the same methodology as a technical subject teaching

7) When teaching you

A) speak only English in lessons

B) speak about 70 % of the lesson time in English and 30 % Czech

C) speak about 50 % of the lesson time in English and 50 % Czech

D) speak about 30 % of the lesson time in English and 70 % Czech

8) Teaching a technical subject in English helps to develop students'

A) language skills

B) subject knowledge

C) both language skills and subject knowledge

D) neither language skills nor subject knowledge

E) other (specify) ………………………………………………………………….

9) When a technical subject is taught in English, students can learn

A) more information because

…………………………………………………………………………………………..

B) less information because

…………………………………………………………………………………………..

10) Do you use only English technical texts for teaching a technical subject in English?

A) Yes

Give reasons why:

…………………………………………………………………………………………………..

B) No

Give reasons why:

…………………………………………………………………………………………………..

11) What type of exam must students take in your technical subject in English?

A) written exam

Give reasons why:

…………………………………………………………………………………………………..

B) oral exam

Give reasons why:

…………………………………………………………………………………………………..

C) both written and oral exam

Give reasons why:

…………………………………………………………………………………………………..

12) What do you focus mainly on when preparing materials for teaching a technical subject in English?

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

13) What is most beneficial for the students who learn a technical subject in English and why?

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

14) What is least beneficial for the students who learn a technical subject in English and why?

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..