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Integrating content and language in teacher development: CLIL for academic vocabulary growth in Algeria

Mengintegrasikan konten dan bahasa dalam pengembangan guru: CLIL untuk pengembangan kosakata akademik di Algeria

Saida Tobbi
Batna 2 University, Algeria
Corresponding Email: s.tobbi@univ-batna2.dz

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Abstract
This study investigates the impact of Content and Language Integrated Learning (CLIL) on academic vocabulary development and disciplinary understanding among newly recruited teachers at Batna 2 University, Algeria. Conducted within the framework of the national teacher development program, the research examined how integrating English into the teaching of research methodology could enhance both linguistic competence and conceptual learning. A mixed-methods framework integrated quantitative and qualitative approaches, including an Academic Vocabulary Test, a corpus of participants' written tasks, and reflective questionnaires. Sixty-eight teachers from twenty-three academic departments participated in eight weeks of CLIL-oriented instruction. Quantitative findings revealed notable improvements in receptive and productive academic vocabulary ($t(67) = 14.27$, $p < .001$, $d = 1.37$), alongside marked increases in lexical diversity, sophistication, and density. Thematic analysis indicated greater lexical awareness, cognitive engagement with research concepts, and positive perceptions of English as a medium for disciplinary learning. The results suggest that CLIL-oriented pedagogy promotes deep processing of academic lexis and supports Algeria's ongoing transition toward English-medium higher education. Embedding content and language objectives within teacher education programs can therefore strengthen linguistic competence and disciplinary literacy in multilingual academic contexts.

Abstrak
Penelitian ini menyelidiki dampak dari Pembelajaran Terintegrasi Konten dan Bahasa (*Content and Language Integrated Learning* atau CLIL) terhadap pengembangan kosakata akademik dan pemahaman disiplin ilmu di kalangan dosen yang baru direkrut di Universitas Batna 2, Algeria. Dilaksanakan dalam kerangka program pengembangan guru nasional, penelitian ini menguji bagaimana integrasi bahasa Inggris ke dalam pengajaran metodologi penelitian dapat meningkatkan kompetensi linguistik sekaligus pembelajaran konseptual. Kerangka kerja metode campuran mengintegrasikan pendekatan kuantitatif dan kualitatif, yang mencakup Tes Kosakata Akademik, korpus tugas tertulis partisipan, dan kuesioner reflektif. Sebanyak enam puluh delapan dosen dari dua puluh tiga departemen akademik berpartisipasi dalam delapan minggu instruksi berorientasi CLIL. Temuan kuantitatif mengungkapkan peningkatan yang signifikan dalam kosakata akademik reseptif dan produktif ($t(67) = 14,27$, $p < ,001$, $d = 1,37$), bersamaan dengan peningkatan nyata dalam keragaman, sofistikasi, dan kepadatan leksikal. Analisis tematik menunjukkan kesadaran leksikal yang lebih besar, keterlibatan kognitif dengan konsep penelitian, dan persepsi positif terhadap bahasa Inggris sebagai media pembelajaran disiplin ilmu. Hasil penelitian menunjukkan bahwa pedagogi berorientasi CLIL mendorong pemrosesan leksis akademik secara mendalam dan mendukung transisi Algeria yang sedang berlangsung menuju pendidikan tinggi bermedia bahasa Inggris. Oleh karena itu, menanamkan tujuan konten dan bahasa dalam program pendidikan guru dapat memperkuat kompetensi linguistik dan literasi disiplin ilmu dalam konteks akademik multibahasa.

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A. Introduction

CLIL has achieved growing international recognition as an effective instructional model that combines disciplinary instruction with foreign language learning (Laili & Mulyati, 2024). It enables learners to acquire disciplinary knowledge while simultaneously developing linguistic competence, thereby fostering deeper cognitive processing and communicative engagement. Grounded in the dual-focused principle of learning content via language and language via content (Coyle et al., 2010), CLIL aligns with constructivist and sociocultural perspectives on learning. In the past two decades, CLIL has become a cornerstone of educational innovation in multilingual contexts, responding to global demands for bilingual and multilingual competence in academia and the workplace. More broadly, it has expanded from a European bilingual education initiative into a globally diffused multilingual educational model aligned with EU plurilingualism policies and with the worldwide need for bi- and multilingual disciplinary literacies in university study, business, and vocational fields such as hospitality (e.g., Hu et al., 2023; Nijhawan, 2022; Dalton-Puffer, 2011; Hüttner et al., 2025). In Algeria, this orientation is particularly meaningful because English is increasingly used in higher education as a means for accessing research literature, preparing academic publications, and participating in international scientific exchange (Melouah, 2023).

While CLIL and English-Medium Instruction (EMI) have been extensively researched in established bilingual education systems, comparable investigations within emerging English-medium contexts such as Algeria remain scarce. This international shift toward English has, however, recently inspired significant reform in Algeria's higher education sector, where English is increasingly viewed as a means for academic advancement and internationalization (Tobbi, 2025). However, despite this policy orientation, most newly recruited university teachers' English proficiency is not yet sufficient for confident academic reading, writing, and oral exchange. This need for language support is congruous with findings from Suherman et al. (2024) and Muzaki et al. (2025), who show how technology-assisted language learning can support vocabulary development outside the classroom among university students not majoring in English. In 2023–2024, Algeria's Ministry of Higher Education and Scientific Research launched a nationwide professional development program to train newly recruited university teachers in pedagogy, educational psychology, digital literacy, and English communication. The English module, designed for teachers from non-English disciplines such as engineering, biology, and sports sciences, aims to enhance their ability to engage with research literature, publish academic work, and participate in international scientific exchange. English majors are exempt from the program, as they already possess advanced linguistic qualifications. Through this initiative, Algeria joins the global movement toward English-mediated academic development, where language proficiency and disciplinary competence are cultivated in tandem.

Research on CLIL has evolved from a practical bilingual education model into a robust interdisciplinary domain that intersects applied linguistics, language pedagogy, and cognitive psychology. Recent scholarship has moved beyond defining CLIL as a pedagogical innovation to exploring its cognitive, linguistic, and disciplinary outcomes. This shift reflects a growing interest in understanding how integrated instruction promotes deep learning processes and supports learners' ability to construct knowledge through language. CLIL research has thus expanded from descriptive accounts of implementation to more empirical investigations that assess linguistic and conceptual development across educational levels and disciplines (Dalton-Puffer et al., 2022).

Among the most consistent findings in literature are CLIL's positive effects on vocabulary acquisition. Numerous studies have shown that CLIL students surpass their counterparts in conventional EFL settings in both vocabulary breadth as well as depth, with structured lexical input and textbook-based scaffolding also supporting vocabulary development (Castellano-Risco et al., 2020). At the primary and secondary levels, Agustín-Llach and Canga Alonso (2015) and Seregély (2008) demonstrated that CLIL learners develop broader receptive vocabularies and retain new words more effectively than EFL learners. Agustín-Llach and Canga Alonso's longitudinal study revealed that CLIL participants consistently achieved greater receptive vocabulary scores,

especially in later grades, indicating that lexical advantages strengthen with increased exposure and proficiency. Similarly, Seregély (2008) found that content-integrated instruction fostered greater vocabulary retention and active use, highlighting CLIL's capacity to enhance lexical learning in young learners. Further evidence from Austrian secondary education adds nuance to this pattern. Gierlinger and Wagner (2016) conducted a mixed-methods study examining vocabulary growth in a CLIL setting and found that while CLIL instruction positively influenced receptive vocabulary size, these effects were largely co-determined by input frequency rather than external factors. Their findings suggest that vocabulary gains under CLIL may vary according to linguistic input quality and pedagogical focus, cautioning against overly optimistic assumptions about automatic linguistic improvement in mixed-ability contexts.

In higher education, the research focus has shifted toward the relationship between CLIL, EMI, and academic literacy development. Doiz et al. (2019) and Dalton-Puffer (2023) emphasize that CLIL fosters disciplinary knowledge and academic communication skills, while Dafouz and Smit (2016) argue that CLIL promotes "knowledge construction through language." Similarly, Castellano-Risco et al. (2020) reported that bilingual CLIL university students demonstrated significantly larger receptive academic vocabularies than those in EFL programs, confirming CLIL's potential to enhance both linguistic and cognitive dimensions of learning in academic settings. Additional higher education research supports this claim from different perspectives. Carloni (2012), examining CLIL implementation at the University of Urbino in Italy, showed that online self-study scaffolding within a counterbalanced CLIL framework enhanced students' awareness of academic language and subject-specific terminology. The integration of corpus-based materials and self-access learning tools encouraged active, autonomous vocabulary development aligned with learners' disciplinary goals. More recently, Borshchovetska et al. (2024) provided empirical evidence from a Ukrainian CLIL context, revealing that the application of cognitive strategies significantly improved professional vocabulary acquisition. Using ANCOVA analysis, they found that learners exposed to cognitively demanding CLIL tasks achieved higher vocabulary proficiency than those in control groups, confirming that mental effort and strategic engagement are central to durable lexical gains. At the school level, Safitri et al. (2024) reviewed CLIL practice in Indonesian primary classrooms, emphasizing teachers' pivotal role in integrating vocabulary scaffolding and content learning. Their analysis revealed that while CLIL promotes vocabulary growth and communicative competence, successful implementation depends on teachers' linguistic proficiency, pedagogical support, and access to appropriate instructional materials.

Despite this growing research base, much of the evidence has concentrated on school-age or undergraduate learners, while far less attention has been paid to professional or postgraduate populations, whose linguistic development interacts closely with disciplinary expertise and professional communication. The evidence from studies such as Borshchovetska et al. (2024) and Carloni (2012) further suggests that cognitively rich and technologically supported CLIL approaches can enhance vocabulary acquisition across diverse educational stages, yet few investigations have explored these mechanisms among academic professionals. This underexplored dimension is particularly relevant in emerging English-medium systems such as Algeria, where higher education institutions are undergoing significant linguistic and pedagogical reform. Reflecting this global shift, Algeria has recently adopted policies promoting English as the language of teaching and scholarly research, creating an urgent need for evidence-based approaches that can support teachers' academic and linguistic development. Few studies have examined how CLIL-oriented instruction functions within a national teacher-training program for newly recruited university teachers in such an emerging English-medium context, and even fewer have investigated its effect on academic vocabulary growth in Research Methodology instruction. The present study addresses this gap by examining the effects of CLIL-oriented instruction in research methodology on academic vocabulary growth and disciplinary engagement among newly recruited university teachers at Batna 2 University. Specifically, it is guided by the following research questions:

(1) To what extent does CLIL-oriented instruction in research methodology affect the academic vocabulary development of newly recruited Algerian university teachers?

(2) How do participants perceive English's role as a medium for learning and articulating disciplinary and research-related concepts?

The theoretical grounding of this study draws upon three complementary models—Coyle's 4Cs framework, the Depth of Processing and Involvement Load theories, and the construct of Lexical Richness. Together, these perspectives provide a coherent explanation of the interaction between language learning and disciplinary content in CLIL contexts to facilitate academic vocabulary development. Coyle's (2007) 4Cs framework conceptualizes CLIL as a dynamic interaction among four interdependent dimensions: Content, Communication, Cognition, and Culture. Learning occurs when these dimensions operate in balance—disciplinary content provides the conceptual core, communication serves as the linguistic channel through which knowledge is constructed, cognition engages advanced cognitive skills such as analysis and evaluation, and culture situates learners within broader academic and epistemic communities. Within this model, language does not serve only to transmit information; it also acts as an instrument for building disciplinary meaning. In the Algerian teacher training context examined here, this framework captures the pedagogical reality of the Research Methodology module, where participants learn to articulate complex methodological concepts through English while simultaneously internalizing the academic register of research discourse.

In this study, the cognitive dimension of Coyle's framework aligns directly with Depth of Processing principles, as learners engage in high-involvement lexical tasks that transform conceptual understanding into linguistic mastery. The hypotheses of Involvement Load (Laufer & Hulstijn, 2001) and the Depth of Processing (Craik & Lockhart, 1972) both posit that vocabulary retention is determined by the degree of semantic elaboration and mental effort involved in processing new items. CLIL-oriented instruction naturally creates such conditions by embedding target lexis in meaningful disciplinary contexts that require inferencing, reformulation, and application. Tasks such as discussing validity, triangulation, or reliability in English generate a high involvement load because they simultaneously activate the three cognitive operations of need, search, and evaluation—dimensions identified by Laufer and Hulstijn as essential for durable lexical acquisition. Through these cognitively demanding activities, participants engage in deep semantic processing that converts exposure into active control, leading to sustained lexical gains and more precise disciplinary expression.

To operationalize these pedagogical and cognitive processes, the study adopts Lexical Richness as its analytical construct. Lexical Richness comprises three interrelated dimensions—diversity, sophistication, and density—which together capture the range, quality, and informational weight of learners' lexical production (Laufer & Nation, 1995; Kyle & Crossley, 2015). Lexical diversity reflects the range of different word types in a text, sophistication captures the use of infrequent or academic vocabulary, and density refers to the proportion of content words relative to total words, indicating informational specificity. In CLIL settings, these dimensions provide reliable indicators of how learners internalize and deploy academic lexis as they engage with disciplinary content.

These three models are combined because each explains a different but complementary dimension of CLIL-oriented vocabulary development. Coyle's 4Cs framework accounts for the pedagogical combination of content, cognition, communication, and culture within the Research Methodology module. The hypotheses of Depth of Processing and Involvement Load explain why vocabulary is retained more effectively when learners engage with words through meaningful, demanding, and task-based use. Lexical Richness provides the analytical lens used to observe the outcome of this process in participants' written production, particularly in terms of vocabulary diversity, sophistication, and density. Together, these models make it possible to explain not only how CLIL is implemented in this study, but also why it is expected to support academic vocabulary growth among newly recruited university teachers in Algeria.

When integrated, these three frameworks offer a comprehensive theoretical lens for interpreting the outcomes of CLIL-oriented instruction. Pedagogically, the 4Cs model explains how content–language integration creates the conditions for meaningful learning. Cognitively,

Depth of Processing and Involvement Load theories account for the mental mechanisms that transform exposure to academic vocabulary into durable knowledge. Linguistically, the construct of Lexical Richness allows these processes to be observed empirically in learners' written production. In the context of Algerian higher education, this integrative model illuminates how English-mediated methodological instruction promotes not only lexical expansion but also epistemic growth, positioning language learning as an intellectual and professional act rather than a purely linguistic exercise.

B. Method

An exploratory mixed-methods design was employed to examine how CLIL-oriented instruction in research methodology influences the academic vocabulary development of newly recruited Algerian university teachers. To achieve this, the study integrated quantitative corpus-based lexical analysis with qualitative reflective inquiry. This combination made it possible to measure changes in vocabulary use while also examining participants' perceptions of English as a medium for disciplinary learning. Such a methodological choice was essential, as the study sought to capture not only linguistic outcomes but also the cognitive and experiential dimensions of CLIL-based learning, thereby aligning closely with the overarching research questions.

The participants consisted of 68 teachers selected through criterion-based purposive sampling from the national training program at Batna 2 University. They were selected because they represented the exact target population of the study: newly recruited non-English-specialist university teachers who were enrolled in the Ministry's professional development program and needed support in academic English for reading, writing, and discussing research methodology. Initially, 71 teachers were recruited; however, three English-major teachers were excluded since their advanced proficiency did not represent the target population of non-specialists. The final sample represented 23 academic departments spanning natural sciences, engineering, and the humanities. All were newly appointed lecturers with roughly two months of teaching experience and thus shared similar professional backgrounds.

Table 1. Characteristics of the Study Participants

Variable	Description
Initial recruitment	71 teachers
Final sample	68 teachers
Sampling method	Criterion-based purposive sampling
Inclusion criterion	Newly recruited university teachers enrolled in the national training program
Exclusion criterion	English-major teachers with advanced proficiency
Institutional context	Batna 2 University
Academic status	Newly appointed lecturers
Teaching experience	Approximately two months
Disciplinary coverage	23 departments
Field distribution	Natural sciences, engineering, and humanities
Relevance to the study	Non-English specialists needing academic English support

To establish a baseline of linguistic proficiency, all teachers took an institutional placement test in accordance with the Common European Framework of Reference for Languages (CEFR). Although the program stipulated that C2-level teachers would be exempted, none reached this threshold. The placement-test results therefore showed that the participants ranged from A1 to C1, with no teacher reaching the exemption level. Consequently, the sample included participants with proficiency levels ranging from A1 to C1, and none had previously studied or worked in an English-speaking environment—conditions that ensured a consistent basis for examining lexical growth among professionals with limited exposure to English.

The instructional component of the investigation was designed as an English for Academic Purposes (EAP) module integrating academic English with content related to research in

education, science, and technology. Over eight weeks (16 sessions of two hours each), participants were exposed to core research concepts such as hypothesis formulation, variables, validity, reliability, triangulation, and academic argumentation. Instruction adhered to CLIL principles by simultaneously developing conceptual understanding and linguistic competence. In practice, this involved scaffolding content through English while drawing explicit attention to academic lexis, collocations, and phraseological accuracy.

Learning activities included guided reading of research articles, corpus-based vocabulary exploration, collaborative discussions, and short writing tasks. Early sessions focused on building lexical awareness through engagement with research abstracts and academic texts. As the course progressed, participants increasingly applied newly learned vocabulary through paraphrasing, exemplification, and peer feedback. Continuous formative feedback encouraged refinement of lexical precision and syntactic cohesion across successive writing drafts.

To document learning outcomes, three complementary instruments were used: an Academic Vocabulary Test, a corpus of learner writing, and a reflective questionnaire. The Academic Vocabulary Test—adapted from the Vocabulary Levels Test (Schmitt et al., 2001) and Coxhead's (2000) Academic Word List—comprised 60 items measuring receptive and productive knowledge. Receptive items assessed recognition and meaning association, while productive items required contextualized use of target words. A pilot test with 20 comparable teachers yielded satisfactory reliability (Cronbach's $\alpha = .87$). The test was administered at the beginning (Week 1) and end (Week 8) of the program.

The written corpus included all textual outputs produced during the module: a diagnostic task, four short writing assignments (300–400 words each), and a final reflective essay. Each teacher produced an average of 9,800 words, generating a corpus of approximately 670,000 words. Using AntConc 4.0 and LexTutor VocabProfile, the analysis examined lexical diversity (Type–Token Ratio and D-index), sophistication (Academic Word List coverage and low-frequency word use), and density (content-to-function word ratios). Comparisons between early and late writing samples revealed patterns of lexical development over time.

The reflective questionnaire, consisting of twelve items, combined Likert-scale statements with open-ended prompts. It explored participants' perceptions of vocabulary learning, lexical challenges, and the role of English in supporting disciplinary understanding. Their responses offered qualitative insight into how content and language integration shaped the learning process. Vocabulary test and writing corpus quantitative data were processed with the aid of SPSS (version 26). Paired-sample t-tests were performed to examine differences between pre- and post-test means, and effect sizes were computed using Cohen's d. Prior to analysis, normality assumptions were verified to ensure the appropriateness of inferential tests. Additional correlations examined relationships between vocabulary gains and measures of lexical richness in writing. Qualitative data from the questionnaire were analyzed thematically following Braun and Clarke (2006). Coding entailed producing initial codes, identifying themes, and further refining them through iterative comparison. To strengthen reliability, two independent coders analyzed 25% of the data, resulting in high consistency across raters (Cohen's $\kappa = .82$). The quantitative and qualitative findings were then consolidated within a convergent parallel design framework (Creswell & Plano Clark, 2018), enabling cross-validation and deeper interpretation of the results.

To ensure validity and reliability across instruments, several measures were implemented. The Academic Vocabulary Test underwent expert review to establish content relevance and alignment with the study aims, and the pilot administration produced high internal consistency. The Reflective Questionnaire was likewise reviewed for clarity and refined to elicit meaningful responses. Credibility and dependability in the qualitative strand were enhanced through triangulation of data sources, use of NVivo for systematic coding, and peer debriefing. The resulting procedures ensured that the study's findings were both empirically sound and methodologically robust.

Ethical standards were maintained throughout the research process. Participants were supplied with comprehensive information about the objectives of the study, procedures, and

confidentiality safeguards, and all provided written informed consent. Data were anonymized through coded identifiers and stored securely on password-protected university servers. Participation had no bearing on teachers' official evaluation or certification within the national training program. Institutional authorization was obtained from the Ministry of Higher Education and Scientific Research (MESRS), and the study operated under the ethical requirements of the British Educational Research Association as well as GDPR (2016) principles regarding transparency and data protection.

C. Results and Discussion

Quantitative data from the Academic Vocabulary Test and corpus analysis were analyzed using SPSS (v.26). Differences between pre- and post-test means were examined using paired-sample t-tests, and effect size was determined through Cohen's d. Power analysis confirmed sample adequacy (β = .80) for a large effect (d = 1.0), ensuring statistical robustness. Results indicated a notable improvement in participants' receptive and productive academic vocabulary knowledge following CLIL-oriented instruction. The mean score increased from M = 34.12 (SD = 5.04) in the pre-test to M = 48.75 (SD = 4.82) in the post-test, t(67) = 14.27, p < .001, d = 1.37, *95% CI [12.50, 16.76]. This corresponds to an approximate 43% gain in overall vocabulary performance. Such a large effect suggests that CLIL-based disciplinary learning markedly enhanced lexical retention and retrieval, consistent with the depth of processing theory, which advances the view underscores that meaning-oriented, cognitively demanding engagement supports durable lexical gains.

This substantial improvement indicates that participants were not only exposed to new academic vocabulary but were also able to internalize and use it more effectively in disciplinary contexts. The findings suggest that integrating content and language instruction can facilitate meaningful engagement with academic terminology, supporting both comprehension and production. In this sense, CLIL-oriented instruction appears to provide conditions that promote sustained lexical development, particularly among non-English-specialist teachers operating in English-mediated academic environments.

1. Lexical Indices Analysis

Corpus-based lexical analysis provided additional evidence of improvement. Table 1 summarizes changes across key lexical indices—Type-Token Ratio (TTR), D-index, Academic Word List (AWL) coverage, and lexical density—calculated from participants' written research reflections.

Table 2. Statistical Results for Lexical Indices Before and After CLIL Instruction

Index	Pre-Test (M)	Post-Test (M)	Mean Difference	t(67)	p	Cohen's d
Type-Token Ratio (TTR)	00.47	00.58	+0.11	0,418055556	< .001	01.05
D-Index	47.13.00	59.80	+12.67	10.23	< .001	01.12
AWL Coverage (%)	06.42	09.38	+2.96	11.45	< .001	01.20
Lexical Density (%)	48.65	56.41.00	+7.76	0.395138889	< .001	0.067361111

Improvements were significant across all indices, reflecting increased lexical diversity, sophistication, and information load. A correlational analysis (Table 2) revealed strong positive relationships between AWL coverage, lexical density, and D-index (r = .71–.84, p < .01), indicating that academic word growth coincided with richer lexical production and stronger control of academic register.

Table 3. Corpus-Based Lexical Measures Before and After Instruction

Measure	Pre-Instruction Mean	Post-Instruction Mean	Change	Interpretation
Type–Token Ratio (TTR)	00.47	00.56	+0.09	Broader lexical variety
D-index	64.02.00	78.05.00	+14.3	Sustained lexical range
Academic Word List (AWL) coverage (%)	07.08	11.09	+4.1	Greater use of academic vocabulary
Low-frequency words (%)	08.06	12.03	+3.7	Increased lexical sophistication
Lexical density (%)	57	64	7	More content-oriented, academic style

As shown in Table 3, all lexical indices exhibited substantial improvement from pre- to post-instruction, suggesting that CLIL-oriented instruction had a measurable and multifaceted effect on participants' lexical performance. The increase in Type–Token Ratio (Δ = +0.09) and D-index (Δ = +14.3) indicates that learners used a wider and more stable range of vocabulary, reflecting greater flexibility in lexical choice and retrieval. These gains point to enhanced lexical diversity achieved through repeated exposure to and use of specialized academic lexis in authentic communicative contexts.

The 4.1% increase in Academic Word List (AWL) coverage and the 3.7% rise in low-frequency word use demonstrate a shift toward more discipline-specific and less frequent vocabulary, signaling higher lexical sophistication and domain awareness. This pattern aligns with the Depth of Processing and Involvement Load hypotheses, whereby tasks requiring semantic elaboration, reformulation, and contextualized production promote deeper lexical retention and transfer. Similarly, the 7% increase in lexical density reflects a shift toward more content-bearing expressions, typical of academic and research writing, and indicates participants' growing ability to encode complex ideas concisely—an outcome that resonates with the Communication and Cognition features of the 4Cs framework.

Together, these results substantiate that participants' exposure to cognitively demanding content mediated through English produced lexical gains not only in quantity (diversity) but also in quality (sophistication and density), underscoring CLIL's potential to foster advanced academic language development in professional contexts.

Table 4. Correlations Among Lexical Indices

Measure	TTR	D-Index	AWL	Density
TTR	—	.79**	.73**	.71**
D-Index	.79**	—	.84**	.78**
AWL	.73**	.84**	—	.82**
Density	.71**	.78**	.82**	—

Note. $p < .01$ for all correlations.

The strong positive correlations among all lexical indices ($r = .71–.84$, $p < .01$) indicate that improvements in one dimension of lexical richness were systematically associated with gains in others. For instance, the close association between D-index and AWL coverage ($r = .84$) suggests that learners who expanded their lexical range also adopted more academic and specialized vocabulary—a relationship consistent with the notion of cumulative lexical development under cognitively engaging conditions. Likewise, the correlation between AWL coverage and lexical density ($r = .82$) demonstrates that increased use of academic lexis contributed to more content-heavy writing, reflecting participants' growing control over disciplinary discourse patterns.

These interrelations reinforce the claim that CLIL's blend of content and language instruction creates synergistic effects across multiple lexical dimensions rather than isolated vocabulary gains. In this sense, the quantitative data complement the qualitative findings: teachers who reported greater awareness and confidence in using methodological vocabulary also produced texts characterized by higher lexical sophistication and density. This convergence of evidence underscores that lexical growth in CLIL environments is not merely additive but integrative—

emerging from the dynamic interaction between linguistic input, conceptual understanding, and purposeful output.

Thematic analysis of reflective responses yielded three interrelated themes: Lexical awareness and cognitive engagement, Confidence in academic communication, and Integration of language and research knowledge. Together, these themes illustrate how CLIL-oriented instruction fostered both linguistic growth and epistemic engagement among participating teachers.

2. Lexical Awareness and Cognitive Engagement

Participants consistently described a heightened sensitivity to the precise meaning, usage, and collocational patterns of methodological vocabulary such as validity, triangulation, and sampling bias. This awareness was largely attributed to activities requiring learners to define terms, interpret examples, and apply them to their own research contexts.

> "I used to see terms like reliability or sampling error as technical words I had to memorize. Now I try to explain them in my own words before using them." (Teacher 4)
> "When we discussed triangulation, I realized it wasn't only a statistical concept but a way of confirming credibility in research. That changed how I read articles." (Teacher 9)

This theme reflects the cognition dimension of Coyle's 4Cs and aligns closely with the depth of processing principle: participants engaged in deep semantic elaboration, connecting new lexis to conceptual understanding rather than treating it as isolated terminology. These qualitative insights corroborate the quantitative evidence of increased lexical sophistication and AWL coverage, suggesting that deeper cognitive engagement translated into more varied and accurate lexical output.

3. Confidence in Academic Communication

Participants also expressed growing confidence in using English to discuss research, both orally and in writing. They attributed this improvement to sustained exposure to academic discourse and opportunities to articulate methodological ideas collaboratively.

> "At first, I hesitated to explain my research design in English. By the third session, I could defend my choices clearly and use expressions like data triangulation or ethical clearance without overthinking." (Teacher 2)
> "Discussing our mini-projects in English helped me start thinking in academic language—it became easier to explain abstract ideas." (Teacher 6)
> "Even when I make mistakes, I feel that my message is clear and professional. That confidence is new." (Teacher 11)

This theme illustrates the communication dimension of the 4Cs, where meaningful interaction consolidates both linguistic form and professional identity. The lexical density and AWL gains observed in corpus analysis reinforce these reflections, indicating that increased communicative confidence coincided with more sophisticated lexical production.

4. Integration of Language and Research Knowledge

Many participants reported that they no longer perceived English as a separate subject but as an integral part of their disciplinary thinking and academic practice. The process of writing reflections, presenting research proposals, and analyzing published papers in English appeared to merge linguistic and methodological awareness.

> "When I read research articles now, I pay attention to how the authors use terms like variables or limitations. It helps me shape my own argument." (Teacher 13)
> "English is now the language I use to organize my research ideas. When I write in Arabic or French, I still think first in English." (Teacher 8)
> "It feels like language and research are one process. Understanding the concept means knowing how to express it precisely in English." (Teacher 15)

This integrative perception captures the interplay between the content and cognition features of the 4Cs and reflects high involvement load, particularly in the "need" and "evaluation" components of Laufer and Hulstijn's framework. Authentic, discipline-specific tasks required participants to actively search for and evaluate lexical options, fostering durable vocabulary retention.

Overall, the qualitative data reveal that CLIL-oriented professional instruction not only expanded participants' lexical repertoire but also reshaped their cognitive and communicative approaches to research. The convergence between qualitative reflections and quantitative gains strengthens the claim that deep lexical processing occurs when linguistic and disciplinary knowledge are co-constructed within meaningful academic contexts. Quantitative data demonstrated substantial lexical gains, while qualitative findings illuminated the cognitive and communicative mechanisms driving these outcomes. Together, they substantiate the theoretical link between deep processing, meaningful content–language integration, and professional academic development.

The results demonstrated that CLIL-oriented instruction in research methodology produced substantial gains in both receptive and productive academic vocabulary among newly recruited Algerian university teachers. Participants' written reflections revealed greater lexical diversity, density, and precision, suggesting that disciplinary engagement in English effectively promotes the acquisition and activation of academic lexis. These results indicate that CLIL can be successfully extended to professional training settings, providing both linguistic enrichment and disciplinary advancement for university educators.

The significant vocabulary gains observed align with the depth of processing theory and the involvement load hypothesis, both of which emphasize semantic elaboration and cognitive effort in durable vocabulary learning. Participants engaged with complex methodological terms such as validity, triangulation, and sampling bias through tasks requiring definition, application, and evaluation, which promoted deep lexical processing. This pattern reflects a high involvement load that transforms receptive exposure into productive control, confirming that cognitively demanding tasks enhance lexical retention.

These findings also resonate with international research on CLIL and academic vocabulary development. Studies conducted in different contexts, such as those by Borshchovetska et al. (2024), Safitri et al. (2024), and Gierlinger & Wagner (2016) have consistently shown that integrating disciplinary content with language instruction enhances both lexical breadth and depth compared to traditional EFL settings. The current results support this trend, showing that even in professional training environments—where participants are already advanced users of English—CLIL-based instruction continues to yield measurable lexical gains. By aligning with these global patterns, the Algerian experience confirms that content-driven instruction provides a viable route to expanding academic vocabulary in EMI contexts undergoing linguistic reform.

The qualitative results complement the quantitative data by revealing how participants internalized vocabulary learning as part of a broader process of professional and epistemic development. Teachers reported increased awareness of academic lexis, greater confidence in English-mediated communication, and a sense of belonging to an emerging research community. These perceptions correspond to Coyle's (2007) 4Cs framework, particularly the interplay of Cognition and Communication through Content, whereby learners construct disciplinary understanding via language use. The study thus demonstrates that CLIL's pedagogical impact

extends beyond linguistic outcomes to include shifts in professional identity and academic self-efficacy.

Theoretically, the study contributes to CLIL scholarship by illustrating that deep lexical processing can occur even among expert learners when disciplinary content elicits sufficient cognitive challenge and communicative need. It further clarifies the connection between the cognitive dimension of Coyle's model and depth of processing principles, offering empirical evidence that conceptual engagement is a primary mechanism of durable vocabulary learning. By applying this model to a teacher education context, the study expands CLIL's traditional scope, demonstrating its relevance not only for students but also for teachers whose linguistic and professional development are intertwined.

Overall, the findings affirm that CLIL-oriented instruction can effectively support both linguistic and disciplinary growth in higher education. Pedagogically, the study showcases the potential of CLIL-based professional development to strengthen academic vocabulary, disciplinary engagement, and teachers' confidence in EMI environments. Theoretically, it draws attention to the importance of cognitive depth and high involvement load as key drivers of vocabulary acquisition in content-integrated contexts. In emerging EMI systems such as Algeria's, these insights may guide future curriculum design and teacher training, ensuring that English-medium reform promotes both linguistic competence and academic expertise.

D. Conclusion

This study demonstrated that CLIL-oriented instruction in research methodology can significantly enhance university teachers' academic vocabulary and disciplinary engagement within English-mediated higher education. The results reveal that integrating content and language learning enables teachers to internalize academic lexis through meaningful disciplinary use, leading to measurable linguistic and epistemic development. Such outcomes highlight CLIL's relevance not only for students but also for professional educators navigating new English-medium environments.

Pedagogically, the findings affirm the need to embed English within disciplinary instruction in teacher education programs. When language serves as the vehicle for constructing and communicating subject knowledge, it ceases to be taught in isolation and becomes a genuine tool for professional reasoning. This approach strengthens teachers' ability to articulate complex ideas, engage critically with research, and participate in international academic discourse—skills increasingly required in globalized academia.

At the policy level, the study underscores the importance of aligning Algeria's English-medium initiatives with sustained, research-informed professional training. Rather than treating English proficiency as a prerequisite, higher education institutions should view it as a developmental outcome achieved through content-integrated practice. Such alignment would ensure that EMI reforms promote both disciplinary mastery and linguistic competence, fostering a generation of teachers who can operate confidently in multilingual academic spaces.

Future research should deepen and broaden these insights in several directions. First, longitudinal studies could explore the durability of lexical gains and whether teachers continue to expand and refine their academic vocabulary once the training program concludes. Second, comparative studies across disciplines could reveal how fields such as engineering, humanities, or life sciences mediate the interaction between content and language, offering discipline-sensitive models of CLIL in higher education. Third, qualitative inquiry should investigate how teachers transfer the integrated pedagogical principles experienced in training into their own classroom practices, potentially shaping students' academic literacy development. Finally, cross-national research could examine how similar professional CLIL initiatives operate in other emerging EMI contexts, contributing to a more global understanding of teacher development through integrated instruction. Collectively, these directions would not only extend the empirical reach of CLIL

research but also reinforce its theoretical claim that language learning is inseparable from disciplinary and professional growth.

E. AI Declaration

During the preparation of this manuscript, the author utilized Perplexity.ai for proofreading assistance. Every AI-generated suggestion was subsequently reviewed, edited, and verified by the author, who bears sole responsibility for the published content.

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Appendices

Appendix A: Academic Vocabulary Test

Sample Items

No.	Word	Type	Task Example
1	Corroborate	Receptive	Choose the correct synonym: (a) confirm, (b) contradict, (c) summarize.
2	Parameter	Receptive	In quantitative research, a parameter refers to: (a) a limitation of the study, (b) a numerical characteristic of a population, (c) an instrument used for testing.
3	Empirical	Productive	Complete the sentence: "An _____ study relies on data derived from observation or experimentation."
4	Inferential statistics	Productive	Define inferential statistics and provide an example of its use in your field.
5	Operationalize	Receptive	Select the correct meaning: (a) to make a concept measurable, (b) to analyze linguistic structures, (c) to summarize data visually.
6	Mitigate	Productive	Use mitigate in a sentence describing how researchers reduce bias.
7	Discrepancy	Receptive	Which sentence best uses the word discrepancy? (a) "There was a discrepancy between expected and observed results."
8	Epistemological	Productive	Define epistemological and briefly explain its relevance to research methodology.
9	Robustness	Receptive	Choose the correct definition: (a) strength of evidence, (b) sample size, (c) variable control.
10	Triangulation	Productive	Write a short explanation of how triangulation improves the validity of a study.

Appendix B: Corpus-Based Lexical Indices

Measure	Description	Indicator of …
Type–Token Ratio (TTR)	Ratio of unique words to total words	Lexical diversity
D-index	Standardized measure of lexical variety	Lexical range
Academic Word List (AWL) coverage	Percentage of AWL items	Academic vocabulary use
Low-frequency words (%)	Share of infrequent words (beyond 2K list)	Lexical sophistication
Lexical density (%)	Proportion of content words	Information load / academic style

Appendix C: Reflective Prompt Shee

Section A: Items 1–6: Likert-scale statements (1 = Strongly Disagree to 5 = Strongly Agree) Assessing Perceived Lexical Development and Communicative Confidence.

- I can now use research-related vocabulary (e.g., *validity, sampling bias, triangulation*) more accurately in English.
- Discussing research methodology in English has improved my understanding of key concepts.
- I feel more confident expressing academic ideas in English during discussions or presentations.
- I now pay more attention to collocations and contexts when learning new research terms.
- I consider English an essential part of my professional identity as a university teacher.
- I find that using English to study methodology helps me think more critically about my discipline.

Section B: Open-Ended Prompts

- Describe one research-related term you learned and how you applied it.
- How did the English instruction help you understand methodological concepts?
- What challenges did you face when expressing disciplinary ideas in English?
- How confident do you now feel using English to discuss your research?
- In what ways do you think your use of English and your understanding of research are connected?

Author Information

Saida Tobbi
Faculty of Letters and Foreign Languages, Batna 2 University
53 Constantine Rd., Fesdis, Batna, Algeria
Email: s.tobbi@univ-batna2.dz
Orcid: https://orcid.org/0009-0005-9602-3411