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The Productive Freeze in Medical ESP: Investigating Lexical Gaps in the Multilingual Learning Environment of the Tamanrasset University Annex

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ABSTRACT

Algeria is witnessing a considerable shift to English-Medium Instruction (EMI) in the domain of medical education, and students in university annexes are encountering unique linguistic obstacles within a complex multilingual settings. The study investigates lexical gaps and the 'productive freeze' among medical students (N=30; representing a complete census and comprehensive enumeration of the available population) at the Tamanrasset University Annex, where Arabic, Tamahaq, and French intersect with specialized English. The study is based on a triangulated mixed-method design which combines data from a student questionnaire, a localized disciplinary corpus of 74,522 words, and semi-structured interviews with six subject-matter professors. The results reveal a fundamental 'receptive-productive paradox': students can identify 'static labels' on anatomical diagrams, but experience a communicative blockage when required to narrate functional biological processes. Quantitative profiling of the corpus reveals two main structural triggers for this freeze: an average sentence length of 32.3 words, which is higher than the students' productive scaffolding, and a 46% technical saturation threshold, which exceeds their marginal 4% Academic Word List (AWL) repertoire. Moreover, moderation analysis ($p=0.005$) shows that a "French mental foundation" facilitates the initial recognition of the

term but induces persistent orthographic and phonetic interference. The study concludes that the lexical crisis is not a failure of general English proficiency but rather a structural response to technical saturation and syntactic complexity. The research suggests bridging this gap by moving away from memorization towards collocation-based learning and the use of "Continuous Functional Scaffolding" after the first year of study. The findings contribute to a context-sensitive account of Medical ESP in the southern part of Algeria and provide a replicable framework for institutions undergoing the transition to EMI in similar multilingual ecologies.

Keywords: Medical ESP, Productive Freeze, Lexical Gaps, Localized Corpus, EMI in Algeria, Multilingualism, Receptive-Productive Divide.

1. Introduction

1.1 EMI IN ALGERIAN HIGHER EDUCATION AND MEDICAL STUDIES

Today, English is a major language of medical communication, scientific research publishing, professional exchange and this role is becoming increasingly important in the medical context of Algeria. The work of Outemzabet and Sarnou (2023) in an Algerian university hospital institution has demonstrated that the use of English is no longer limited to research publications but has extended to professional, educational, and social practices related to medical work; this change is highly significant in language teaching, as it shows that the students in medical specialities need more than general skills in English; they acquire a wealth of specialized medical vocabulary to understand, discuss, and exchange medical knowledge effectively.

1.2 THE LOCAL LEXICAL PROBLEM AT TAMANRASSET UNIVERSITY

However, Algerian higher education takes place in a multilingual sociolinguistic context. This context is shaped by the fact that, in Algeria, the most frequently used languages are Arabic, French, Tamazight, and English (Rouabah, 2022). All of these languages have their significance in their respective domains. Consequently, students do not start learning English for specific purposes from a neutral language base. It starts with a repertoire already layered with prior schooling, everyday communication, and access to academic resources across multiple languages.

Studies on Tamahq in southern Algeria show that the language retains functional social vitality, but is under pressure from other codes. Terriche (2021) describes a slow shift in which speakers, especially children, tend to gravitate towards dialectal Arabic in informal domains. More generally, research on Algeria describes a multilingual environment where Modern Standard Arabic (MSA), Algerian Arabic (Derja), Tamazight, French, and increasingly English are used in public settings (Rouabeh, 2022).

1.3 THEORETICAL FRAMEWORK

The present study draws on a framework that brings together vocabulary theory, ESP needs analysis, and corpus-based inquiry. According to Nations (2001), receptive vocabulary

is the set of words that the learner can recognize and relate to meaning, whereas productive vocabulary is the set of words that the learner can use appropriately in writing and speaking. This distinction is necessary because in Medical ESP, students may read and comprehend technical terms they may not use when completing assignments, joining discussions, or accomplishing other educational tasks.

Two main linguistic phenomena need precise scholarly definitions in order to operationalize the fundamental theoretical concepts of this study :

Lexical gap: according to ESP and applied linguistics , a lexical gap is the discrepancy between learners existing vocabulary and the vocabulary needed to understand and generate a discipline specific discourse in a target field (Flores, 2011; Nekrasova-Baker et al., 2019 ;Peters & Fernández, 2013). Le and Miller (2023) and Nekrasova et al. (2019) describe this gap in terms of structural incompatibility between general lexis and specialized lexis, and it encompasses academic, semi-technical, cross-disciplinary and basic technical vocabulary. Because of the context-dependent (i.e. situation-dependent) polysemy of semi-technical vocabulary, it presents a challenging situation (Le & Miller, 2023).

Productive Freeze: According to Cheng & Matthews (2018) and Edmonds et al. (2022), a lexical problem, also known as 'productive freeze' in this case, refers the learners' inability to use specialized terminology and expressions that they do understand. This is especially evident in ESP cases when learners have to use (semi-)technical collocations, and thereby, produce discourse in a field of specialization (Le & Miller, 2023; Nekrasova-Baker et al., 2019; Peters & Fernández, 2013). As a consequence, a large discrepancy occurs between adequate understanding and restricted production.

Completing this vocabulary perspective, Hutchinson and Waters (1987) also stress that ESP course design should start by asking why learners need English. This makes needs analysis important for identifying both the vocabulary difficulties students face now and the academic language demands they will face later. A corpus-based perspective adds another useful layer because it helps the researcher examine the actual vocabulary found in the texts students are expected to read and use in university study (Biber, 2006)

1.4 AIM AND RESEARCH QUESTIONS

In this context, the present study investigates lexical gaps in Medical ESP among Tamanrasset University students by examining how their multilingual learning condition shapes access to English medical vocabulary. More specifically, it seeks to identify the lexical difficulties students experience, to examine the gap between receptive and productive vocabulary knowledge, and to relate these learner difficulties to the lexical demands of disciplinary texts.

Our study raises the following Questions:

- What lexical gaps do Medical ESP students at Tamanrasset University encounter, and how do these gaps reflect the receptive, productive vocabulary Knowledge?

- What does a frequency analysis of localized medical disciplinary texts reveal about the lexical demands students encounter, and how do these demands compare with students' reported vocabulary knowledge?
- How do subject-matter professors perceive medical students' lexical difficulties, and what institutional barriers and strategic pedagogical shifts do they identify to overcome the 'productive freeze' in Medical ESP?

We hypothesize that:

- Medical ESP students possess significantly higher receptive vocabulary knowledge than productive ability, resulting in a "productive freeze" during active communication.
- Students encounter greater lexical barriers with semi-technical and process-oriented vocabulary (e.g., proliferation, differentiation) than with highly specialized technical terminology.
- Subject-matter professors perceive that institutional barriers, specifically ESP-subject teacher isolation and time constraints, exacerbate the 'productive freeze,' which is further moderated by a 'French mental foundation' that aids initial recognition but causes persistent orthographic and phonetic interference during active production.

1.5 SIGNIFICANCE

The study aims to provide a more context-sensitive account of Medical ESP learning in southern Algeria and to generate evidence that can support more precise vocabulary instruction and course design in multilingual university settings.

2.1 EMI IN ALGERIA

Algeria is a particular multilingual reality in which Modern Standard Arabic, Tamazight, French and English have (often unequal) access to power and material resources and where their institutional value is a major determinant of language policy (Rouabah, 2022). Recent policy revisions reflect a focus on multilingualism at the policy level, fostering both linguistic diversity (i.e., by boosting the importance of French and English) and wider acknowledgment of Tamazight as other official language in education. Language practices, however, continue to serve as a point of tension between official and foreign languages that still closely intersect with North African inequality, knowledge access, and the political struggle over legitimacy and status (Rouabah, 2022).

At the national level, English has become increasingly important in higher education, as shown by current policy debates on its status and by university teachers and students who advocate for its expansion (Maraf, 2024). The emergence of EMI has been a notable topic of discussion, and the literature on EMI attitudes has revealed perceptions among educators and students of the nature of English in their academic practices and institutional change (Touahmia & Bakar, 2024) It is this realist perspective that renders English-centered instruction in Algeria not just a pedagogical adaptation but a language-in-education reform

that unfolds within an unequal, politicized multilingual paradigm (Rouabah, 2022; Maraf, 2024; Touahmia & Bakar, 2024).

The most obvious instance this larger change is happening is in medical settings. As pointed out by Outemzabet and Sarnou (2023), the Algerian communities are multilingual and diglossic, and English is not used only in research publications. Indeed, it is assuming a greater role in professional, educational and social communication, even in spheres previously dominated by French. Meanwhile, Djaileb (2018) refers to the current constraints of ESP delivery within medical education, while Moussedek (2020) highlights the persistent issues of developing basic English skills, especially listening skills, of medical students. These studies reveal that English is becoming more and more popular in Algerian medicine, but the teaching infrastructure that was expected to support this shift inconsistent.

In Tamanrasset, this difficulty is compounded by the local linguistic realities. Terriche (2021) documents a small but ongoing language shift in Tamahaq where younger speakers tend to use Algerian Arabic (Derja) in informal contexts, Standard Arabic in formal contexts, and increasingly incorporate French and English. That is, the students of Tamanrasset do not share a common linguistic background regarding Medical ESP. Instead, students enter English through the established repertoires of Tamahaq, Arabic, and the broader multilingual ecology of Algerian higher education (Medfouni, 2019; Terriche, 2021). However, it is not conceivable to consider EMI and ESP as neutral language strategies in such a situation. Instead, they must be understood as complex shifts in identity, language and demanding voice (Preece, 2022).

2.2 MEDICAL ESP LEXICAL DEMANDS

Vocabulary is at the heart of ESP research since specialized learning is not only about the accuracy of grammar or general communicative ability. According to Hutchinson and Waters (1987), ESP can be defined as a learning-centered approach to understanding learners' needs with respect to the target language, and vocabulary knowledge comprises not only receptive but also productive knowledge (Nation, 2001). This distinction is especially relevant in Medical ESP, where learners may recognize a term in reading or listening, but are unable to use it correctly in writing, explanation, or classroom discussion. This gap can be even broader for bilingual or multilingual learners, since they may understand a concept in one language but cannot express it in English.

To achieve unassisted reading comprehension, students must understand approximately 95% of text running words (Wang et al., 2008). Standard academic word lists are not an ideal solution, as Coxhead's Academic Word List (AWL) correlates with specialized medical lists at only 54.90%, leaving students ill-prepared for field-specific demands (Wang et al., 2008). The real difficulty often lies in semi-technical vocabulary and directional terms (e.g., anterior, epithelial), the very places where passive recognition fails to become active production (Wang et al., 2008). In addition, Le and Miller (2023) found 302 semi-technical words that are confusing because of polysemy or because they are structurally similar to regular English

words, and this confirms that lexical gaps involve familiar-looking phrases that have rigid, field-specific meanings in medical discourse

2.3 CORPUS-INFORMED ESP DESIGN.

Corpus linguistics serves as a productive tool connecting linguistic description with ESP pedagogy. Flowerdew (2015) argues that corpus research has an evident pedagogic value as it allows researchers and teachers to investigate individual lexical items, phraseology, lexical bundles, rhetorical functions and move or genre patterns in academic discourse. Likewise, Biber (2006) demonstrates that university registers exhibit distinct vocabulary and lexico-grammatical patterns that can be empirically described through corpus-based analysis. For ESP research, this supports a course design grounded in the recurring lexical, rhetorical, and register features of the texts that learners are expected to read and produce, rather than in intuition alone (Flowerdew, 2004).

Recent developments in medical English have advanced one step further and incorporated corpus analysis directly into syllabus and materials design. Fraser et al. (2025) also point out the benefit of adding a medical English vocabulary list into curriculum materials for medical students, as well as software tools allowing students to work through texts themselves and create their own vocabulary lists. A key strength of this study is that it shows one way in which needs analysis, corpus-based vocabulary selection, and materials design can be integrated into a single pedagogy, as part of growing vocabulary, as a curricular centerpiece.

2.4 Research Gap

The literature suggests three stable conclusions: First, English is expanding in Algerian medical and higher-education contexts, but this expansion occurs within a multilingual environment characterized by unequal language histories and uneven pedagogical support. Second, Medical ESP demands control of academic, technical, and semi-technical vocabulary, while the receptive-productive divide remains a key challenge for learners. Third, corpus-based approaches offer a strong basis for selecting relevant vocabulary and designing more precise ESP materials. What remains less well described in the Algerian literature is how these three issues intersect in a southern multilingual context such as Tamanrasset, where students' multilingual repertoires shape their encounters with and processing of English medical vocabulary.

3. METHODOLOGY

3.1 RESEARCH DESIGN METHODOLOGY

This study adopts a triangulated mixed-methods design. The design is appropriate because it brings together quantitative, qualitative, and corpus-based evidence within a single framework, allowing the researcher to investigate one problem from complementary angles rather than relying on a single source (Creswell & Plano Clark, 2018). In the present study, triangulation is necessary because lexical gaps in Medical ESP cannot be explained solely by learner self-report (questionnaire) or by textual analysis. They need to be examined

through what students report, what the local disciplinary texts require, and what teachers observe. We will rely on three tools: a questionnaire, a localized medical corpus, and semi-structured interviews.

The research also considers lexical difficulty as a context-specific issue influenced by the multilingual background of students in Tamanghasset. Accordingly, the mixed-methods design integrates three different levels of analysis:

- The first level is how the student thinks about how hard the vocabulary is.
- The second level is the vocabulary used in the English medical texts that students need to read.
- The third level is how experts understand those problems in teaching practice

This structure keeps the methodology aligned with the theoretical framework that is based on multilingual learning, the receptive-productive divide, needs analysis, and corpus linguistics.

The empirical data is structured in the context of a descriptive-analytical frame (Mlih & El Assouli, 2020, p. 37). The descriptive part is to identify and classify the main factors such as receptive vs. productive competence and multilingual interference, and the analytical part is to process the field data and statistically test the study hypotheses with SPSS.

3.2. Study Settings and Delimitations

The study was conducted at the Medical Annex of the University of Tamanrasset, El Hadj Moussa Akk Akhamouk, in southern Algeria. This context is highly relevant because students in the region are immersed in a complex multilingual educational setting where Arabic, French, English and local linguistic practices intersect. In this setting, English has become an increasingly crucial medium for higher education and future professional career advancement in Algeria. The following delimitations were set to determine the boundaries and scope of this study:

3.2.1. SPATIAL DELIMITATIONS: The geographical scope of this empirical investigation was strictly bound to the Medical Annex at the University of Tamanrasset.

3.2.2. TEMPORAL DELIMITATIONS: The research was carried out, and its measurement instrument was administered, throughout the period of April to July of the 2025-2026 academic year.

The context in which the 'receptive-productive gap' is considered becomes of paramount importance, since the students' linguistic background, which is mainly Arabic and Tamahaq, constitutes the cognitive foundation on which the specialized Medical English is acquired.

3.3 Participants and Sample Profile

3.3.1 Target Population and Census Sampling Method

The study population consisted of undergraduate students of the University Medical Annex of Tamanrasset during the academic year 2025-2026. Given the restricted population size, a complete census enumeration method was implemented (Patton, 2015), yielding a final sample of $N = 30$ participants (a 100% response rate of available students). This comprehensive population coverage guarantees a high level of statistical reliability and internal validity for this particular multilingual ecology.

3.3.2 Demographic and Academic Characteristics

The demographic, sociolinguistic, and academic profile of the participant cohort ($N = 30$) was systematically categorized across seven key variables (see Table 1).

Demographic / Academic Variable	Category / Subgroup	Percentage (%)
Gender	Female	66.7
	Male	33.3
Academic Year	First-Year	46.7
	Second-Year	53.3
First Language (L1)	Arabic	76.7
	Tamahaq	20.0
	Tamazight	3.3
Language of Daily Use	Arabic	76.7
	Tamahaq	20.0
	Tamazight	3.3
Age	18 years	16.7
	19 years	43.3
	20 years	16.7
	+Age 21 years	23.3
Self-Reported English Proficiency	weak	23.33
	Average	26.7
	Good	40.0

	Very Good	10.0
Frequency of Reading Medical English	Never	10.0
	Rarely	13.33
	Sometimes	46.67
	Often	13.33
	Always	16.67

N = 30 represents a complete census enumeration of the available medical student population at the annex.

The sample is predominantly female (66.7%, $n = 20$), reflecting the wider demographic trends in Algerian medical faculties as shown in Table 1. The participants demonstrate strong age homogeneity (60.0% aged 18–19 years) and operate within a deeply rooted multilingual repertoire. Arabic was the main native language (76.67%, $n = 23$) and the main language used in everyday communication, which is also the main means of daily communication, complemented by a significant local Tamahaq representation (20.0%, $n = 6$). Importantly, the 100% correlation between L1 and everyday language use shows that neither French nor English is actively spoken outside the classroom, confirming that exposure to English remains limited to university coursework.

Methodologically, the sample captures a balanced distribution between first-year (46.7%, $n = 14$) and second-year (53.3%, $n = 16$) students. This division is analytically significant, because first-year students are actively and formally taught ESP, while second-year students have suddenly been cut off from language support, at a point when their medical studies are becoming more demanding. Notably, while 50.0% ($n = 15$) of the students evaluated their overall English proficiency as 'Good' or 'Very Good', 46.7% ($n = 14$) read English medical materials only 'Sometimes'. This reveals a fundamental 'proficiency paradox' in which general language ability does not protect students against specialized technical saturation. The 'productive freeze' is a result of disciplinary lexical barriers rather than a general deficiency in basic English grammar.

3.4. DATA COLLECTION INSTRUMENTS

The data were collected at the Medical Annex of Tamanrasset University during April–July of the academic year 2025–2026 using a three-step sequential procedure.

3.4.1 Questionnaire Structure, Dimensions, and Measurement

A structured student questionnaire was adopted as the primary research instrument to collect the empirical data required to test the research hypotheses. To ensure the scientific reliability of the tool, the questionnaire items were created based on recent literature in applied linguistics and English for Specific Purposes (ESP). These items were carefully adapted to match perfectly with the academic tasks and psycholinguistics characteristics of

medical students . Additionally , the instruments development and conceptualization of its dimensions were based on the in-depth investigation of the complex factors associated with lexical reception and production, technical barriers, linguistic interference, and academic contexts

The student questionnaire consisted of eight thematic sections to prepare for the multidimensional nature of Medical ESP lexical processing in a multilingual setting (see Table 01). Following the demographic and language profile screening (Parts 1–2), the instrument assessed the four constituent dimensions of the study: Multilingual Environment (Part 3), Situational Contexts of the Productive Freeze (Part 4), Recall and Production Problems (Part 5), and Learner Pedagogical Needs (Part 6). Part 7 measured specialized vs. semi-technical lexical barriers and Part 8 measured French orthographic/phonetic interference

Table 2
General Structure of the Questionnaire Variables and Dimensions with SPSS Codes

Part	Main Variables	Sub-variables and Dimensions (SPSS Codes)	Number of Items
First	Demographic and Academic Data	Gender (DEM_Gend), Age (DEM_Age), Academic Year (Dem_Year), First Language (DEM_L1), Daily Language (DEM_DailyLang), English Level (DEM_EngLevel), Reading Frequency (DEM_FreqRead).	7
Second	Multilingual Strategies and Interventions	Language inputs (MLE_input), Strategies (MLE_Strategy), Code-switching (MLE_Switch), Benefits (MLE_Benefit).	4
Third	Self-Assessment of Receptive and Productive Competence	Receptive and productive knowledge (SELF_C1, SELF_C2, SELF_C3, SELF_C4, SELF_C5, SELF_C6).	6
Fourth	Retrieval Problems and Cognitive Freeze	Recognition (RPP_Recog), Freeze (RPP_Freeze), Forgetting (RPP_Forget), L1 Recall (RPP_L1Recall).	4
Fifth	Lexical and Technical Barriers for Terminology	Word positions (DIFF_Posit), Abbreviations (DIFF_abbre), Process-oriented terms (DIFF_Process), Adjectives (DIFF_Adj), Latin/Greek roots (DIFF_Root), Spelling (DIFF_Spell).	6
Sixth	Linguistic Interference (French Mental Foundation)	Mental translation (INT_Trans), Reliance on mediator (INT_Depend), Cognates (INT_Cognate).	3

Seventh	contexts and of Situations of Productive Freeze	Oral situations (SIT_Oral), Lab/Practical sessions (SIT_Lab), Exams (SIT_Exam).	3
Eighth	Pedagogical Needs	Proposed tasks and needs for curriculum development	8
Total	Total Questionnaire Variables	Comprehensive Integration of the Field Measurement Tool	41

Source: Prepared by the researcher(s)

For Parts 3 to 8, item responses were evaluated using a closed-ended 5-point Likert scale (frequency and agreement) ranging from 1 (Never / Strongly Disagree) to 5 (Always / Strongly Agree). All items were framed unidirectionally so that higher numerical values consistently indicated greater frequency of use, higher perceived need, or more severe lexical difficulty.

3.4.2 LOCALIZED MEDICAL CORPUS

The next stage of the study consisted of the systematic compilation and characterization of a localized medical corpus, in order to go beyond general intuition and to provide a 'context-sensitive account' of the particular vocabulary needs in Tamanrasset. This tool was based on corpus-based research, a method highly regarded for its ability to empirically describe the frequency, lexical collections, and register differences of specialized language. Biber (2006) has shown how this type of analysis can empirically characterize the unique lexical patterns of academic registers. As an instrument, it was tailored to the particular academic context of the Medical Annex, and it allowed for the identification of the 'lexical challenges' faced by students on a daily basis, which provided an empirical basis of comparison with learner-reported difficulties. This approach is consistent with the claim that the design of ESP courses should be based on the stable features of texts that learners often read, not merely on intuition.

3.4.2.1. Compilation and Standardization

The data harvesting and compilation of this corpus was carried out between April and July of the academic year 2025-2026, a period chosen to align with the students' engagement in specialized coursework. The corpus was systematically constructed from teaching materials of six core modules: Anatomy, Physiology, Cytology, Histology, Embryology, and Human Health Security. To ensure that the corpus reflected the authentic linguistic environment of the local pedagogical context, the data sources were mainly lecture slides, handouts, and practical laboratory worksheets.

The acquired materials were submitted to a rigorous process of digitalization and standardization. All documents were transformed into plain-text (.txt) format to be compatible with the automated analysis tools. In this step, the integrity of the lexical frequency count was preserved by removing all non-textual components such as images, charts, and diagrams. After standardization, the files were merged and uploaded to Voyant

Tools for automated processing, which allowed for the description of recurrent lexical patterns and frequency distributions that were specific to the annex.

3.4.2.2 SAMPLING AND BENCHMARKING

To ensure methodological transparency, the lexical distribution analysis was performed following a systematic three-stage process. First, the 74,522-word medical corpus in the localized version was analyzed by Voyant Tools to produce a full frequency list. From this automated output, a high-frequency sample of the top 300 unique word families was extracted, containing a statistically significant total of 19,261 tokens (around 25% of the entire corpus). Finally, these 300 tokens were analyzed in Microsoft Excel, where they were manually cross-referenced and categorized against established linguistic benchmarks, namely Coxhead's (2000) AWL, Wang et al.'s (2008) MAWL, and Le and Miller's (2023) semi-technical list to calculate the final frequency percentages and identify the technical saturation threshold.

3.4.3 SEMI-STRUCTURED INTERVIEWS

The third instrument used in this study is a semi-structured interview, where the researcher interviewed six assistant professors of medicine at the Tamanrasset University Medical Annex. The participants were chosen based on their clinical and academic skills, English language proficiency, and the ongoing transition in Algerian higher education to English-medium instruction (EMI). The purpose of these interviews is to collect qualitative expert views on the lexical difficulties encountered by students and to explore the effect of these difficulties on students' engagement with discipline-specific medical knowledge. This aligns with recent qualitative studies on medical English education which have utilized interviews to investigate language proficiency, specialized vocabulary and pedagogical challenges (Zolfaghari et al., 2025).

A primary focus was the distinction between students' receptive and productive knowledge of medical terminology. The interviews examined whether students could identify specialized vocabulary without the capacity to retrieve and employ it in academic contexts. This difference is important because receptive and productive vocabulary skills may not develop at the same rate or meet the same communicative needs (Malmström et al., 2018).

The semi-structured format allowed the researcher to investigate issues such as multilingual interference and what the study calls a 'productive freeze'. Participants also discussed specific lexical and pedagogical issues within their respective medical modules. Furthermore, the interview data helped to contextualize an 'educational rupture', which the study defines as an analytical interpretation of the relationship between students; linguistic backgrounds and the demands of English-medium medical education. The combination of these expert interviews and vocabulary analysis provided a qualitative basis for interpreting the lexical barriers identified in the study

Table 3: Participant Profiles (Expert Informants)

Professor	Subject taught	Teaching experience	Language of teaching
Professor / P1	Anatomy	12 years	French, Arabic, English
Professor / P2	Physiology	09 years	French, Arabic, English
Professor / P3	Cytology	07 years	French, Arabic, English
Professor / P4	Histology	15 years	French, Arabic, English
Professor / P5	Embryology	08 years	French, Arabic, English
Professor / P6	Human Health Security	14 years	French, Arabic, English

Source: Prepared by the researcher based on interview data

Table 3 reveals that the participants possess varied medical expertise with teaching experience of 7 to 15 years. Each professor practices in the multilingual teaching environment of the annex, using French, Arabic, and English to varying degrees in their teaching. This expertise baseline is crucial for validating the study's findings, as these professors witness the students' linguistic struggles on a daily basis during lectures and practical laboratory sessions. The data collected from these interviews were then thematically analyzed, focusing on the identification of the 'French mental foundation' and the specific systemic barriers that hinder the transition from receptive recognition to active oral and written production in Medical ESP.

3.5 PSYCHOMETRIC PROPERTIES OF THE STUDY INSTRUMENT

3.5.1. QUESTIONNAIRE VALIDITY

The internal consistency validity, which assesses the structural homogeneity of the instrument, was evaluated by analyzing item content, response processes, and inter-item correlation coefficients (Abu Allam, 2006). For each dimension, i.e., self-evaluation, lexical barriers, productive freeze, and linguistic interference, a Pearson correlation coefficient was calculated. In order to ensure the best psychometric accuracy, a systematic filtration was applied to the final instrument, removing any non-significant items and those with weak correlations ($r < 0.30$), following methodological standards in the field (Cheddad & Chibout, 2025).

Table 4 Pearson Correlation Coefficients Between Items and Total Score of Each Dimension (Internal Consistency Validity)

Dimension and Items	Pearson Correlation (r)	Sig. (2-tailed)	Sample (N)
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Multilingual Inputs (MLE)			
Multi-language input during lectures/slides	.571**	.001	30
Using L1 (Arabic/French) to understand English	.865**	.000	30
Switching between languages while studying	.657**	.000	30
Knowledge of other languages helping English comprehension	.775**	.000	30
Recall & Production Problems (RPP)			
Recognition on diagrams vs. inability to explain	.874**	.000	30
Understanding in con but unable to produce when needed	.756**	.000	30
Rate of forgetting new medical terms	.816**	.000	30
Better recall when explained via another language	.852**	.000	30
Linguistic & Technical Difficulties (DIFF)			
Difficulty with positional/directional terms (Anatomy)	.802**	.000	30
Difficulty with abbreviations and acronyms in medical English	.782**	.000	30
Difficulty with process verbs (Physiology/Embryology)	.607**	.000	30
Difficulty with descriptive adjectives (Histology)	.620**	.000	30
Difficulty with Latin/Greek roots	.841**	.000	30
Difficulty with spelling (French interference)	.688**	.000	30
French Interference (INT)			
Translating from L1 before speaking/writing	.862**	.000	30
Depending on L1 explanations to understand	.867**	.000	30
Confusion with similar-looking English/French terms	.784**	.000	30
Contexts & Situations (SIT)			

Problems appearing during oral questions	.796**	.000	30
Problems appearing during practical lab sessions	.910**	.000	30
Problems appearing during exams	.752**	.000	30
Pedagogical Needs (NEED)			
Specialized medical word lists (e.g., Anatomy, Physiology)	.710**	.000	30
Support with prefixes, suffixes, and roots in medical terminology	.816**	.000	30
Practice focused on sequencing and narrative tasks	.747**	.000	30
Practice with common medical collocations and expressions	.814**	.000	30
Multilingual glossaries or other familiar linguistic resources	.615**	.000	30
Digital tools, such as flashcards or vocabulary apps	.854**	.000	30
Vocabulary activities based on the s used in medical courses	.800**	.000	30
Support with vocabulary used in oral academic interaction	.737**	.000	30
Receptive Knowledge			
Understanding core medical terms when reading in English	.609**	.000	30
Understanding medical terms when hearing in lectures	.515**	.004	30
Inferring meaning of unfamiliar medical words from context	.755**	.000	30
Sufficiency of English medical vocabulary for current studies	.465**	.010	30

Source: SPSS Output

Table 4 shows the results of the Pearson correlation analysis to verify the internal consistency validity of the research instrument in its eight dimensions for the total sample (N=30). The statistical outputs showed that all the correlation coefficients were positive and highly significant at $p < 0.01$ and $p < 0.05$ levels of significance. This confirmed the strong structural cohesion and homogeneity of the questionnaire.

The correlation coefficients ranged from an acceptable low of .465 (fourth item of the cognitive self-evaluation variable) to an extremely high peak of .910 (laboratory sessions dimension/SIT_Lab), indicating that linguistic challenges are most strongly associated with applied and laboratory-based medical environments.

These comprehensive data confirm the absence of anomalous items and provide the empirical instrument with a high degree of psychometric reliability, according to the strict academic frameworks established within the national university environment.

3.5.2. Questionnaire reliability.

Instrument reliability is the degree of consistency in results when the same measurement tool is applied to the same sample under the same conditions, which reflects the basic trustworthiness of the instrument (Bishta & Bouamousha, 2020). In this study, the **Cronbach's alpha** coefficient was used to assess internal consistency.

Two items of the dimension of self-evaluation (related only to the productive skills of speaking and writing) were excluded to arrive at the best levels of objectivity. This exclusion was necessitated by their failure to reach statistical significance during internal consistency validity testing and their lack of correlation with receptive language items. Consequently, the final reliability analysis was performed on 32 structurally homogeneous items.

Table 5 Reliability Statistics (Cronbach's Alpha)

Cronbach's Alpha	N of Items
0.928	32

Source: SPSS Output

Table 5 shows that the overall reliability coefficient was 0.928. This value can be considered excellent and highly robust, well above the standard empirical minimum threshold of 0.7. Such a high level of internal consistency underscores the structural stability and precision of the instrument, ensuring that the findings are reproducible under identical academic condition. This decisive statistical outcome confirms the psychometric properties of the tool - including its validity and reliability-thereby qualifying the database for the subsequent inferential statistics phase and hypothesis testing.

4. PRESENTATION AND ANALYSIS OF THE STUDY RESULTS

4.1 The Descriptive Context Of The Academic Environment

Before testing statistical hypotheses and analyzing causal relationships, the methodological trajectory requires an initial exploration of the linguistic and situational realities of the medical training environment. This section aims to diagnose the 'hybrid educational environment' by presenting the descriptive statistics for the four constituent dimensions of the questionnaire: Multilingual Learning Environment (MLE), Educational

Situations and Contexts (SIT), Processing and Production Patterns (RPP), and Student Needs (NEED). Table (06) illustrates the means and standard deviations for the variables across these dimensions, thereby establishing a robust foundation for the interpretation of the subsequent inferential findings

Table 6 Descriptive Statistics for Multilingual Environment, Processing Patterns, and Learner Needs

Dimensions and Variables	N	Mean (M)	Std. Deviation (SD)
1. Multilingual Environment (MLE)			
- Knowledge of other languages helping English comprehension	30	04.03	1.188
- Switching between languages while studying	30	3.76	1.194
- Multi-language input during lectures/slides	30	3.70	0.915
- Using L1 (Arabic/French) to understand English	30	3.56	1.356
2. Situational contexts (SIT)			
- Problems appearing during oral questions	30	3.96	1.098
- Problems appearing during practical lab sessions	30	3.76	1.165
- Problems appearing during exams	30	3.26	1.362
3. Recall & Production Problems (RPP)			
- Better recall when explained via another language	30	3.73	1.362
- Recognition on diagrams vs. inability to explain	30	3.66	1.372
- Understanding in con but unable to produce when needed	30	3.53	1.224
- Rate of forgetting new medical terms	30	3.53	1.382
4. Pedagogical Needs (NEED)			
- Practice focused on sequencing and narrative tasks	30	4.10	1.268
- Practice with common medical collocations and expressions	30	3.96	1.272
- Support with vocabulary used in oral academic interaction	30	3.93	1.387
- Support with prefixes, suffixes, and roots in terminology	30	3.86	1.252
- Digital tools, such as flashcards or vocabulary apps	30	3.86	1.332
- Specialized medical word lists (e.g., Anatomy, Physiology)	30	3.80	1.242
- Vocabulary activities based on s used in medical courses	30	3.80	1.297

- Multilingual glossaries or other familiar linguistic resources	30	3.53	1.455
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Source: SPSS Output

The descriptive data presented in Table (06) clearly show the academic and linguistic setting of the medical students' experience across four basic dimensions. The learners in the MLE show a high dependence on the existing linguistic repertoires to help the understanding of the English (M=4.03). The use of code-switching as a constant cognitive strategy (M=3.76) In educational contexts, lexical barriers are most pronounced in direct oral questioning (M=3.96) and laboratory activities (M=3.76), where the need for immediate cognitive retrieval presents challenges far greater than those encountered in written examinations (M=3.26).

The Processing and Production Patterns (RPP) dimension provides further evidence for the 'productive freeze' phenomenon. Students' ability to recognize visually (M=3.66) and in context (M=3.53) is significantly higher than their ability to actively explain or produce terms. Therefore, the dimension of Student Needs (NEED) shows the need for prioritized functional task-based training such as sequencing of biological processes (M=4.10), mastery of medical collocations (M=3.96), and scaffolding of oral academic interaction (M=3.93).

These results indicate that students are very aware that 'productive freeze' can be broken through communicative and sequential training, and not through mechanical memorizing of isolated vocabulary.

4.2. Testing Hypothesis 1: Receptive vs. Productive Knowledge Divide

The first hypothesis of the study postulates that: 'Medical students possess a receptive lexical competence and repertoire that significantly exceeds their productive capacity, thereby leading to the phenomenon of 'productive freeze' during actual communicative attempts'. The following table 7 was constructed in order to validate this hypothesis statistically and to quantify exactly the magnitude of the gap between the receptive and the productive levels. It presents the results of descriptive statistics and Paired samples t-test.

Table 7 Paired Samples Statistics and T-Test for Receptive vs. Productive Knowledge

Pair 1	Mean	N	Std. Deviation	Std. Error	T	df	Sig. (2-tailed)
Receptive_Mean	3.23	30	0.61370	0.11205	1.878-	29	0.70
Productive_Mean	3.61	30	0.91617	0.16727			

Source: SPSS Output

The first hypothesis of this study is that the receptive lexical competence of medical students is significantly higher than their productive capacity, which causes a 'productive freeze' in the process of communication. To test this, a Paired-Samples t-test was performed to compare the mean scores of receptive knowledge and productive capacity.

The inferential analysis revealed a t-value of -1.878 (df=29), two-tailed significance of $p=0.070$. While this value is higher than the traditional alpha threshold of 0.05, indicating the difference between the receptive ($M=3.23$) and productive ($M=3.61$) means is not statistically significant for the total study population, there is significant individual variability among students in the data. The higher standard deviation of productive capacity ($SD=0.916$) in compared to receptive knowledge ($SD=0.613$) suggests that the “productive freeze” is not a consistent state, but rather a divergent cognitive challenge that affects students with different intensity.

The qualitative evidence of subject-matter experts strongly supports this statistical trend. Professors P1 and P4 found a constant ‘receptive-productive paradox’ in real life, which showed that students are able to show ‘functional visual recognition’ on diagrams but struggle from a total communicative block when asked to explain processes orally. As Professor P4 noted, a student might be able to identify a tissue under the microscope immediately but be ‘totally unable to verbalize its features in English’. While the group level gap was not statistically significant in the absolute sense, the triangulated data confirms the ‘freeze’ remains a defining experiential reality in the classroom.

4.3 Testing Hypothesis 2: Specialized vs. Semi-Technical Lexical Barriers

The second hypothesis of the study postulates that: ‘Students encounter more serious lexical obstacles when working with semi-technical vocabulary and terms denoting biological processes as compared with their experience with highly specialized medical terminology.’

The first step of empirical testing of this hypothesis was an analysis of the descriptive statistics to determine the actual hierarchical position of these lexical barriers from the perspective of sample participants, as shown in the table below:

Table 8 Descriptive Statistics for Lexical and Technical Barriers

Lexical Barrier (Variable)	N	Minimum	Maximum	Mean	Std. Deviation
Difficulty with Latin/Greek roots	30	1.00	5.00	3.3667	1.27261
Difficulty with descriptive adjectives (Histology)	30	1.00	5.00	3.3333	1.29544
Difficulty with positional/directional terms (Anatomy)	30	1.00	5.00	3.2333	1.25075
Difficulty understanding abbreviations and acronyms	30	1.00	5.00	3.2333	1.25075
Difficulty with process verbs (Physiology/Embryology)	30	1.00	5.00	3.0333	1.18855

Source: SPSS Output

In the descriptive analysis of the item means, it can be observed that the barrier of “Latin and Greek roots” (i.e., highly specialized technical terminology) was the highest, with a mean of (3.366). Conversely, ‘verbs denoting biological processes’ (representing semi-technical vocabulary) anchored the bottom of the ranking with a mean of (3.033). This hierarchical distribution provides a first clue that goes against the direction of the prediction of the hypothesis, which predicted semi-technical terms to be harder.

To test the statistical significance of the differences, variables were aggregated into two major dimensions, semi-technical barriers and highly specialized technical barriers, and subjected to a Paired-Samples t-test as presented in **Table 9**.

Table 9 Paired Samples Statistics and T-Test for Semi-Technical vs. Specialized

Barriers

Pair 1	Mean	N	Std. Deviation	Std. Error	Correlation (r)	t	df	Sig. (2-tailed)
SemiTech_Barriers	3.20	30	0.92889	0.16959	**0.685	-0.64	29	0.524
Specialized_Barriers	3.30	30	1.14921	0.20982				

Source: SPSS Output

The inferential results show that the mean score of the highly specialised technical barriers (M=3.30) was slightly higher than the semi-technical barriers (M=3.20), with a p-value of 0.524. Consequently, we fail to reject the null hypothesis, as specialized terminology was perceived as the primary barrier by this specific cohort. This result seems to be opposite to the existing literature. For example, Le and Miller (2023) argue that semi-technical vocabulary is more difficult for learners than stable technical terms because of its polysemy. This is because the students of the Tamanrasset Annex are under a special ‘comprehensive lexical pressure block’. A strong positive correlation between specialized and semi-technical barriers ($r=0.685$, $p=0.000$) shows that students do not experience such difficulties in isolation, but they are overwhelmed by a 46% Technical Saturation Threshold that affects all linguistic levels at the same time.

Additionally, the ‘French mental foundation’ builds a particular cognitive landscape where French cognates can facilitate the recognition of technical roots and simultaneously cause orthographic interference, so that ‘static labels’ appear as demanding as complex process verbs. At this initial stage of the EMI transition, students are experiencing a ‘first cognitive shock’ because the enormous amount of new terminology, no matter its category, effectively hides the complex polysemy of semi-technical words.

4.4.4 Testing Hypothesis 3: Moderation Model of French Interference

The third hypothesis of the study postulates that: 'The 'French cognitive foundation' moderates the vocabulary acquisition process; while it facilitates the initial recognition of terminology, it simultaneously induces persistent orthographic and phonological interference.'

To empirically validate this hypothesis and to deconstruct the nature of this linguistic interference, an advanced causal modelling approach was used through 'Moderation Analysis'. Since the research population was fully enumerated, a random resampling technique was used (Bootstrapping at 5000 resamples using the PROCESS Macro - Model 1). This strict procedure was used to ensure the maximum stability and accuracy of the statistical parameters and to obtain strict confidence intervals (95% CI).

Table 10 Moderation Analysis and Conditional Effects of Cognate Confusion on Spelling Difficulty

Predictors / Effects	β	SE	t	P	95% CI[LL,UL]
Main Moderation Model					
Constant	-0.336	1.051	-0.320	0.751	[-2.498, 1.825]
L1 Dependence (X)	0.869	0.321	2.705	0.011	[0.208, 1.529]
Cognate Confusion (W)	1.095	0.387	2.828	0.008	[0.299, 1.892]
Interaction (X×W)	-0.229	0.101	-2.253	0.032	[-0.439, -0.020]
Conditional Effects of X on Y at values of W					
Low Cognate Confusion (1.00)	0.639	0.237	2.697	0.012	[0.152, 1.126]
Moderate Cognate Confusion (3.00)	0.179	0.156	1.147	0.261	[-0.142, 0.501]
High Cognate Confusion (5.00)	-0.279	0.275	-1.014	0.319	[-0.846, 0.287]

Source: Prepared by the author(s) based on SPSS / PROCESS Macro statistical outputs.

The moderation analysis, performed by the PROCESS Macro (Model 1), reveals that the hypothesized causal model is statistically significant at a high level ($F(3,26)=5.314$, $p=0.005$) and has strong explanatory power within the field of applied linguistics. The independent and interactive variables explained 38.0% of the total variance of students' orthographic errors ($R^2=0.380$). The results indicate that there was a positive main effect of reliance on mother tongue ($\beta=0.869$, $p=0.011$) and visual confusion of terminology ($\beta=1.095$, $p=0.008$) on error frequency.

The analysis reveals a statistically significant interaction effect between these variables ($\beta = -0.229$, $p = 0.032$, 95% CI $[-0.439, -0.020]$), which explains an additional 12.1% of the variance in the model ($\Delta R^2 = 0.121$). This finding provides definitive evidence that the 'French cognitive foundation' is a moderating variable that fundamentally changes the trajectory of the acquisition of English terminology, and the full acceptance of the third hypothesis is warranted. To clarify the mechanisms of this interference, the analysis of conditional effects shows a clear cognitive shift:

At Low Visual Confusion, only use of mother tongue for interpretation directly predicts orthographic difficulty ($\beta = 0.639$, $p = 0.012$)

At High Visual Confusion: L1 reliance does not predict orthographic difficulty when there is an overlap of strongly visually confusable French and English words ($p = 0.319$)

This points to an 'overwhelming threshold' or 'saturation threshold' where the cognitive load from orthographic and morphological interference is too much. At this point, the French cognitive basis itself becomes the main and dominant source of the 'productive freeze', effectively superseding other cognitive or learning strategies employed by the student.

4.5 Quantitative Profiling of the Localized Medical Corpus

Table 11: Quantitative Summary of the Localized Medical Corpus

Metric Category	Corpus Data/ Result	Pedagogical Significance
Corpus Size	74.522 Total Words	Reflects the high-volume linguistic input across 6 modules
Lexical Variety	7.664 Unique Word Forms	Demonstrates a wide range of specialized medical terminology
Vocabulary Density	0.103	Indicates a highly repetitive and specialized technical register
Readability Index	14.921	Reflects a professional level exceeding learner baseline
Avg . Sentence Length	32.3 Words	Primary trigger for the «productive freeze».

Source: Voyant Tools Output

Table 11 is a quantitative Summary of the Localized Medical Corpus from Voyant Tools. To get a sense of the real language environment at the Tamanrasset Medical Annex, we examined a localized disciplinary corpus, a collection of the students' real teaching materials, including lecture slides, handouts and lab worksheets from six core modules, including Anatomy and Histology..... The corpus contains 74,522 words in total, and 7,664 different word forms. The analysis explains the «environmental pressure» that puts students in a

«productive freeze».

4.5.1. SYNTACTIC COMPLEXITY: THE 32-WORD BARRIER

The data suggest that the texts students are required to read are very complex. The average sentence length is 32.3 words. The Readability Index is 14.921. This complexity is what causes the 'productive freeze'. Students can identify individual labels on a diagram but lack the linguistic 'scaffolding' to construct these long, 32-word sentences on their own. Thus, they know the "parts," but the "sentences" are too long and complicated to make.

4.5.2. Lexical distribution and technical saturation threshold

The analysis of 19,261 most frequent tokens reveals a clear difference between the specialized and the general academic lexis. The critical distinction between Semi-Technical terms (lateral, medial, etc.) and the Academic Word List (AWL) must be maintained. The semi-technical category (high-pressure directional and relational vocabulary) is considerably represented with 27% of the frequency, while the AWL is a marginal 4%. This finding is a major argument for the failure of general ESP courses in this context: traditional instruction that focuses on general academic 'connectors' targets only a tiny fraction of the students' actual linguistic environment. Instead, students are swamped by a 46% Technical Saturation Threshold (MAWL + Semi-Technical) leaving them lacking the specific functional vocabulary to navigate their core modules

Table 12: Lexical Distribution of the Localized Corpus (Sample Analysis)

Lexical Category	Unique Words	Total Frequency	Percentage	Meaning for Students
Medical (MAWL)	40	3.660	19%	Core technical terms (e.g., cell, membrane)
Semi-Technical	68	5.200	27%	Positional terms (e.g., lateral, medial)
Academic (AWL)	12	770	4%	General academic 'linking' words
General English	180	9.631	50%	Basic structural words (e.g., the, is)
Total	300	19.261	100%	Combined Technical Load

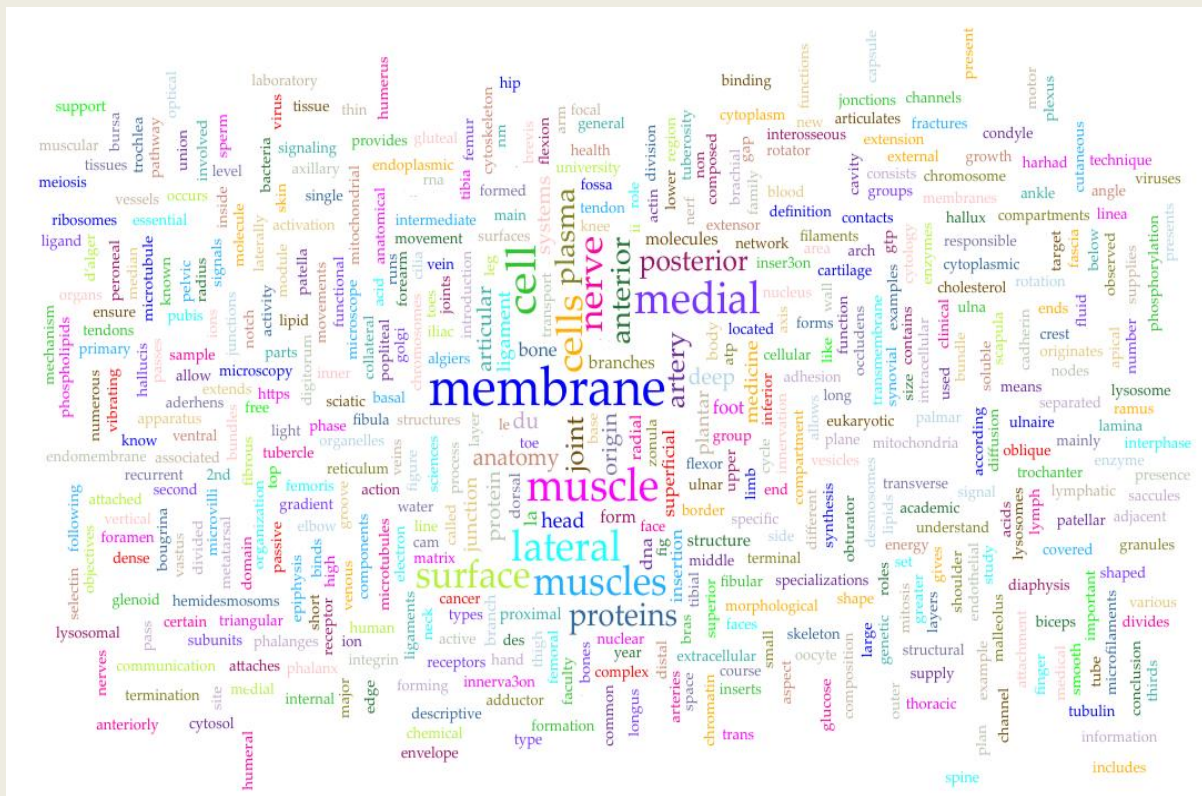
Source: Frequencies extracted via Voyant Tools; Categorization and distribution calculated via Microsoft Excel.

4.5.3. Visual Evidence: Decoding the Word Cloud (Figure 8)

As shown in Figure 8, the high-density map of students' cognitive demands shows three different 'pressure zones' where the physical manifestation of technical saturation is presented (46%). These zones —the Anatomical Load, the Positional-Relational Axis and the Process-Oriented Gaps— offer a visual confirmation of the lexical barriers that trigger the productive freeze as students try to transition from static labelling to fluid narrative.

The Word Cloud (Figure 8) is a high-density map of the students' cognitive demands, i.e., a visual representation of the 'technical saturation' they are exposed to. Membrane (410) and cell/cells (693) dominate the landscape. They represent the 'static labels' that students have successfully mastered at a receptive level. However, this mastery is mitigated by a deep 'narrative deficit'; while anatomical identifiers are visually prominent, the lower frequency of process-oriented verbs such as mitosis, synthesis, and differentiation indicates that students are exposed to the individual 'parts' of the biological machine but lack the linguistic input required to narrate its functional development.

Figure 8 : Students' cognitive demands(loads) Cloud



Source: Voyant Tools Output

Looking more closely at the cloud, we can see three distinct 'pressure zones' that account for the lexical gaps:

Anatomical and microscopic loads: The curriculum includes a large number of high-resolution identifiers. The cloud highlights specific structures like the patella, radius, fibula, pelvis, and phalanges, alongside a dense «microscopic landscape» of organelles such as mitochondria, ribosomes, and the endoplasmic reticulum. These nodes show the amount of specialized technical vocabulary students need to handle on a daily basis.

The Positional-Relational Axis: Relational identifiers represent a second tier of high-pressure vocabulary. The cloud contains important pairs such as proximal (89), distal (70), dorsal (90), superficial (106), and deep (123). The high number of nodes such as anterior (201) and posterior (191) directly reflects the pedagogical reality described in expert interviews, where professors say that students often «mix up pairs» during high-pressure practical exams.

Process-Oriented Gaps: Despite the technical density, the cloud reveals a relatively limited number of the verbs required to describe biological transitions. Words like synthesis, mitosis, meiosis, and interphase, but they all lack the visual significance of the nouns they modify. This confirms that the major lexical barrier for the students is not the recognition of a structure but the productive ability to explain its movement or growth.

4.5.4. Conclusion: Static Labels and Fluid Narratives

The profiling of the localized corpus shows that the lexical crisis is not an overall English failure but rather a structural response to technical saturation. The word cloud is a map of static labels that students can recognize. But the average 32.3-word sentence is a barrier to students moving beyond visual recognition to the dynamic narration of the «biological narrations» their core modules require.

4.6 Discussion and data Triangulation

Table 13: Thematic Analysis of Lexical Gaps and Barriers in Medical ESP

This table presents the thematic coding derived from the qualitative analysis of interviews with six subject-matter professors at Tamanrasset University.

Research Question	Theme	Barriers	Evidence examples from the interview transcription
RQ1:Lexical gaps & receptive versus productive knowledge	The Paradox of Receptive vs. Productive Knowledge	-Functional visual recognition -productive freeze in oral and written tasks -Fragmentation of active vocabulary	-‘Visual recognition is way ahead of their active use. The moment I ask them to actually explain.....they tend to freeze up’ (P1)

			' A student will look through the microscope, recognize the tissue immediately, but be totally unable to verbalize its features' (P4)
RQ1 & Localized Demands Student Knowledge	RQ2: vs.	Disciplinary Lexical Demands and Gaps	• Positional/Directional confusion • Deficiency in process-oriented verbs • Descriptive adjective hurdles • Semi-technical/Administrative gaps - 'Constantly mixing up pairs like anterior and posterior' P1 - 'Missing the specialized academic verbs needed to describe movement and growth words like invagination, proliferation, differentiation' P5 . - 'Entirely unprepared for the semi-technical, administrative English' P6
RQ2 & Language Influence Barriers	RQ3: &	Multilingual Interference	• The "French Mental Foundation" • Orthographic/Phonetic interference • Arabic for conceptual narrative logic - 'Since almost all our medical instruction is explained in French, it becomes their mental foundation' P2.

			-‘Incredibly common for them to... write cellule instead of cell, or to pronounce membrane with a thick French accent’P3. -‘We build the narrative logic in Arabic, [so] their English speaking skills stay unpracticed’ P5
RQ3: Perceptions & Institutional Barriers	Systemic Barriers & Curricular Disconnect	ESP-Subject teacher isolation. • Curricular skew (Anatomy-focus). • Time constraints	-‘The fact that ESP instruction is completely separated from actual histology teaching is our biggest roadblock’P4 -‘The ESP curriculum... almost completely ignores public health policy’P6 -‘Plus time constraint makes any real oral practice almost impossible’P1
RQ3: Teacher Recommendations	Strategic Pedagogical Implications (Shifts)	Localized corpus development. • Focus on active/narrative production. • Collocation-based learning	Instruction needs to shift toward dynamic processes and collocations... like kidneys filter blood’ P2 -‘We need a localized corpus

			made directly from our histology slides, practical sheets, and past exams' P4 - 'The vocabulary needs to be part of exercises that test active production, not just passive recognition' P3
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The qualitative perspectives of subject-matter professors (P1–P6) provide a critical interpretation of how Tamanrasset's unique multilingual ecology shapes specialized English vocabulary acquisition, providing empirical context for the questionnaire data and corpus metrics

4.6.1 The Paradox of Receptive Recognition vs. Productive Knowledge Failure

Across core medical disciplines, faculty Professors unanimously observe a profound disconnect between students' receptive term recognition and their active productive capability. Professor P1 (Anatomy) notes that students' "visual recognition is way ahead of their active use, so they freeze up" when required to explain anatomical functions or positional relationships. This blockage becomes severe during practical laboratory sessions; as Professor P4 (Histology) observes, a student can "look through the microscope, recognize the tissue immediately, but be totally unable to verbalize its features in English". Consequently, vocabulary knowledge becomes "very fragmented" (P2, Physiology), as students comprehend physiological concepts in Arabic or French but lack productive English equivalents.

The qualitative data provide local support for Nation's (2001) distinction between receptive and productive vocabulary knowledge. While student self-reports reflect higher recognition capacity ($M = 3.66$) than productive fluency ($M = 3.53$), corpus profiling reveals the physical mechanism underlying this gap: an average sentence length of 32.3 words. The "productive freeze" is therefore not merely an inability to recall isolated terms, but a structural failure to bridge static anatomical labels with the complex syntactic scaffolding required for active medical narration.

4.6.2 Disciplinary Lexical Demands and Gaps

The frequency analysis of the disciplinary Lexical Demands shows that students face some lexical barriers depending on their module.

Anatomy and Histology: The primary friction points center on positional/relational terms (e.g., anterior vs. posterior, proximal vs. distal; P1) and descriptive adjectives (stratified, squamous, cuboidal, dense; P4).

Physiology and Embryology: The obstacle shifts toward process-oriented verbs. Professor P5 (Embryology) emphasizes that while students label static organs, they miss the "specialized academic verbs needed to describe movement and growth—words like invagination, proliferation, differentiation, and folding".

Human Health Security: The "semi-technical, administrative English" of global epidemiology (P6) causes a "major culture shock" for students, leaving them "completely unprepared" to create professional health warnings or protocols.

These empirical patterns directly validate the warnings of Wang et al. (2008) regarding the insufficiency of general academic word lists for medical undergraduates. The localized corpus shows that Coxhead's (2000) Academic Word List (AWL) only accounts for 4% of text frequencies, while students are dominated by 46% Technical Saturation Threshold (19% MAWL + 27% semi-technical). This massive saturation explains why generic ESP courses focused on general academic linkers fail: they leave learners lacking the specific functional vocabulary needed to navigate core modules. Furthermore, the strong positive correlation between specialized and semi-technical barriers ($r = .685$, $p < .001$) confirms that students perceive the specialized register as an indivisible, overwhelming pressure block.

4.6.3 Multilingual Interference and the 'French Mental Foundation' as a moderator variable

In the multilingual context of Tamanrasset, where Arabic, Tamahaq, French and English intersect, medical logic is delivered orally in French, thus providing a 'French mental foundation' (P2). As it is described in the Algerian language policy literature (Rouabah, 2022; Terriche, 2021), students do not start from a neutral base. This foundation operates as a double-edged sword: French cognates facilitate initial term recognition, but simultaneously generate persistent "spelling and pronunciation interference" (P1, P3). Professor P3 (Cytology) claims it is "incredibly common for them to write cellule instead of cell, or to pronounce membrane with a thick French accent" Arabic also acts as a conceptual anchor but the use of Arabic for "narrative logic" means that students' active English speaking skills are neglected (P5).

The moderation analysis empirically supports this qualitative dynamic ($F(3, 26) = 5.314$, $p = .005$, $R^2 = .380$). The interaction between L1 dependence and cognate confusion ($\beta = -0.229$, $p = .032$) suggests that at high levels of visual confusion, orthographic and morphological interference form a "saturation threshold. Beyond this point, the French mental foundation itself becomes the primary driver of the productive freeze, overriding other cognitive strategies.

In particular, faculty professors stress systemic disconnects as major institutional challenges, including the "complete separation" of standalone ESP instruction from core medical modules (P4, P6). Current ESP provision remains biased toward clinical anatomy;

lab sheets, 3D animations and public health policies are ignored (P6). Severe time constraint (P1) can lead students to just "memorize isolated terms to survive exams" instead of trying to formulate scientific definitions (P3).

To overcome this "receptive-productive paradox", the triangulated evidence supports the corpus-informed ESP frameworks of Biber (2006), Flowerdew (2015), and Fraser et al. (2025). According to faculty consensus, there are three key curricular changes:

Localized Corpus Development: Development of teaching materials based on histology slides, lab sheets and previous exams in the annex (P4, P6)

Collocation-Based Learning: Moving from isolated nouns to dynamic functional collocations (e.g. "kidneys filter blood and "arteries carry oxygenated blood") (P2) to enhance the linguistic connective tissue missing from their 4% AWL repertoire.

Continuous Functional Scaffolding: the Annex should move towards a model of 'Continuous Functional Scaffolding'. Active collaboration between language specialists and medical professors where they co-construct active production tasks (such as writing definitions, describing images, sequencing processes) in Year 1 and Year two.

4.7 Pedagogical Implications and Recommendations for Strategies

To successfully support Algeria's transition to English-Medium Instruction (EMI) in medical education, instructional provision must evolve from isolated general English toward a localized, process-oriented framework. Empirical evidence suggests four strategic curricular shifts:

1. **Collocation-Based Learning:** Teaching should move away from memorizing isolated nouns toward the mastery of dynamic functional collocations (e.g., "kidneys filter blood", "arteries carry oxygenated blood"). This gives students the functional needs which are missing from their AWL .

2. **Continuous functional scaffolding.** Formal ESP instruction needs to continue beyond the isolated First-Year curriculum and be extended into Year 2 and senior pre-clinical studies. Language scaffolding should continue as disciplinary demands increase.

3. **The Shared-Instructional Model animations and clinical slides .**

4. **Contrastive Cognate Awareness:** To address French-English interference, digital resources (e.g., flashcard apps) should explicitly focus on visually confusable terms (e.g., cellule vs. cell) to boost orthographic awareness and avoid cognitive blockage at the saturation threshold.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This study concludes that the lexical crisis observed at the Tamanrasset University Medical Annex is not a failure of general English language proficiency, but rather a structural response to specialized technical saturation and syntactic complexity. Triangulating empirical data, including student self-reports, expert faculty interviews, and automated profiling of a localized disciplinary corpus of 74,522 words, the research reveals a prevalent “receptive-productive paradox.” Medical undergraduates show functional receptive recognition of static anatomical labels on diagrams ($M = 3.66$) but exhibit an extreme “productive freeze” ($M = 3.53$) when asked to actively articulate dynamic biological mechanisms.

In quantitative terms, this freeze is caused by three intersecting physical barriers:

1. A high 46% Technical Saturation Threshold (19% MAWL + 27% semi-technical vocabulary) that swaths learners during specialized text processing.
2. A challenging average sentence length of 32.3 words, exceeding the students’ productive syntactic scaffolding.
3. A “French mental foundation” as a moderating variable ($F(3, 26) = 5.314, p = .005, R^2 = .380$). French cognates facilitate the initial recognition of visual terms, but high visual overlap results in persistent orthographic and phonetic interference during active production.

Ultimately, the results reveal a considerable gap between the students' average 4% Academic Word List (AWL) repertoire and the complex biological narratives required in core pre-clinical modules. To overcome the productive freeze we must move from the rote memorization of isolated technical nouns to active, process-oriented language instruction.

5.2 Limitations and Future Research Directions

While this investigation provides a triangulated, context-sensitive account of Medical ESP acquisition in southern Algeria, it should be acknowledged that it has four specific limitations:

1. Geographical Scope and Population Census (N = 30): N = 30 corresponds to a complete census enumeration of the Tamanrasset Annex; therefore, it has a high internal validity for this specific multilingual ecology, but it is a localized snapshot which may not generalize sufficiently well to larger northern university faculties.

2. Pre-Clinical Horizon: The study was conducted among the first- and second-year undergraduates only to explore initial cognitive shock of EMI. It does not trace the development of the productive freeze during senior clinical hospital rotations (Years 3–7).

3. Learner Self-Reports: Although self-assessments were triangulated with objective corpus metrics and faculty expert interviews, student self-evaluations are at risk of subjective bias. Future studies should include standardized diagnostic vocabulary testing (e.g., PVLIT or VST) to provide an objective psychometric baseline.

4. Regional Multilingual Ecology: The specific sociolinguistics context of Tamanrasset—with 20% Tamahaq presence alongside Arabic and a French mental FOUNDATION—means of orthographic and phonetic interference are strongly tied to this local ecology.

Future Research Directions: we suggest longitudinal cohort studies following students into clinical rotations, and comparative multi-center studies across other EMI medical annexes in southern Algeria will be key for assessing the long-term trajectory of the productive freeze and assessing the wider scalability of continuous functional scaffolding.

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Appendices

