EDU REVIEW | Vol. 14, No. 1, 2026 | ISSN 2695-9917
The International Education and Learning Review / Revista Internacional de Educación y Aprendizaje
https://doi.org/10.62701/revedu.v13.5510

THE USE OF AI IN ANALYSING ENGINEERS WRITTEN SKILLS IN ENGLISH: Corpus-Based Approach to Error Analysis in University Students

El uso de la IA en el análisis de las habilidades escritas en inglés de los ingenieros: Enfoque basado en Corpus para el análisis de errores en estudiantes universitarios

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KEYWORDS

AI in Academic Communication
L2 Acquisition at university level
L1 Interference in L2 acquisition
Corpus Linguistics AI enhanced analysis
STEM Education and Communication
AI solutions for Communicative purposes
Engineering and Communication

ABSTRACT

This study leverages artificial intelligence (AI) to enhance second language (L2) acquisition among Spanish-speaking telecommunication engineering students with B2-level English proficiency, focusing on mitigating first language (L1) interference. Through a neurolinguistic and corpus-based analysis of 120 application letters (60 in Spanish, 60 in English), AI tools like AntConc and Grammarly identify structural, pragmatic, and cognitive errors—such as syntactic transfers, overly formal tones, and convoluted sentences—stemming from cognitive overload and underdeveloped L1 competence. Integrating interference theory with neuroconstructivist and social/pragmatic frameworks, the research proposes AI-driven interventions, including real-time feedback and scaffolded learning, to foster linguistic precision and professional communication skills, offering educators innovative strategies for inclusive L2 learning in STEM context.

PALABRAS CLAVE

Adquisición de L2 a nivel universitario
Análisis mejorado por IA de lingüística de corpus
Educación STEM y Comunicación
IA[AS1.1] en la Comunicación Académica
Ingeniería y Comunicación
Interferencia de la L1 en la adquisición de la L2
Soluciones de IA para fines comunicativos

RESUMEN

Este estudio aprovecha la inteligencia artificial (IA) para mejorar la adquisición de segundas lenguas (L2) en estudiantes hispanohablantes de ingeniería de telecomunicaciones con un nivel de inglés B2, centrándose en mitigar la interferencia de la primera lengua (L1). Mediante un análisis neurolingüístico y basado en corpus de 120 cartas de solicitud (60 en español y 60 en inglés), herramientas de IA como AntConc y Grammarly identifican errores estructurales, pragmáticos y cognitivos —como transferencias sintácticas, tonos excesivamente formales y oraciones enrevesadas— derivados de la sobrecarga cognitiva y de una competencia deficiente en la L1. Integrando la teoría de la interferencia con los enfoques neuroconstructivista y sociopragmático, la investigación propone intervenciones basadas en IA, como la retroalimentación en tiempo real y el aprendizaje andamiado, para fomentar la precisión lingüística y las habilidades de comunicación profesional, ofreciendo a los educadores estrategias innovadoras para el aprendizaje inclusivo de L2 en contextos STEM.

Received: 08/ 01 / 2026
Accepted: 20/ 04 / 2026

1. Background

The acquisition of a second language (L2) is a complex cognitive process that requires the integration of new linguistic structures, lexical items, and pragmatic conventions into an already established first language (L1). University students, especially in non-English speaking contexts, often face significant challenges in achieving L2 proficiency, particularly in academic and professional settings. These difficulties are exacerbated by the cognitive demands of mastering multiple language systems simultaneously, often leading to errors that hinder effective communication and academic success (Ellis, 2015). Such errors are often influenced by L1 interference, limited exposure to authentic L2 input, and insufficient metalinguistic awareness (Jarvis & Pavlenko, 2008).

Establishing the previous errors as potential motivators of English as L2 communicative inaccuracies, a corpus was designed collecting a total of 120 letters of application written by second-year telecommunications engineering students. The corpus consists of 60 letters written in Spanish (L1) and 60 letters written in English (L2). This enabled a comparative analysis of the linguistic structures, proficiency-related challenges associated with mastering the language and the professional communication strategies in both languages.

In this context, AI (artificial intelligence) becomes a useful tool in the analysis of wide amounts of data given the correct prompts and parameters, and helps turn hypotheses into manageable data. Accordingly, AI was used in this study to provide support in analysing communicative errors in written language for both Spanish and English, providing a deeper understanding of the motivators behind such errors and becoming a benchmark for communication, enhancing strategies which could ensure professional success for Engineers (FECYT, 2019).

2. Communicative errors

The term communicative errors suggests a broad concept, thus, for the particular case of this study, these errors are understood as linguistic inaccuracies in written language which follow any of the following criteria:

- Lexical and syntactic complexity- as for the case of the sample group, this focuses on what the Common European Framework recommends for a B2 level in English.
- Genre-specific features – Identifying formal register elements in professional
- Writing.
- Technical terminology – Assessing how students incorporate field-specific
- language in both languages.
- Common grammatical, lexical, and structural mistakes in L2 writing.
- Pragmatic strategies – Exploring cultural and rhetorical differences in persuasion and self-presentation.

The choice of the particular criteria shown in the list above, has been stemmed from the study of different linguistic theories aimed at analysing communicative domains namely the concept of lexical density (Ure, 1971) and theories of second language acquisition (Ellis, 2006) as well as genre-based analysis (Swales, 1990).

Additionally, two theories/ approaches were considered pertinent in their application as benchmark for this corpus analysis: Neuroconstructivist Approach and Social and Pragmatic Theories.

2.1. Neuroconstructivist Approach

For the particular case of the present study this approach is understood as a theoretical framework that views second language (L2) acquisition as an evolving cognitive process influenced by developmental and contextual factors. It emphasizes the dynamic interplay between neural plasticity, cognitive development, and environmental interactions in shaping language learning. This approach posits that L2 errors, such as those observed in the English writing of Spanish-speaking engineering students, reflect developmental stages in linguistic processing, where learners' cognitive systems adapt to new linguistic structures through iterative exposure and practice. These errors range from basic grammatical issues (e.g., incorrect preposition use) to more complex issues like simplified sentence structures and lack of contextual adaptation, indicating a developmental plateau potentially due to limited exposure to varied linguistic input (de Bot et al, 2007; Paradis, 2004).

The neuroconstructivist approach integrates insights from Dynamic Systems Theory (DST), which views language acquisition as a non-linear process influenced by cognitive load, working memory, and environmental factors (de Bot et al., 2007). It underscores how neural networks, shaped by L1 (first language) structures, influence L2 production, leading to errors that reflect incomplete internalization of L2 rules or over-reliance on L1 patterns (Paradis, 2009). For example, errors like "you can contact me if you are interested with a letter" or "hybrical" as indicative of basic-to-intermediate linguistic challenges stemming from underdeveloped grammatical and morphological precision, which align with neuroconstructivist views of language learning as a process of gradual cognitive restructuring (Ellis, 2006).

2.2. Social and Pragmatic Theories

As for the case of this study, these theories embrace frameworks that emphasize the role of sociocultural context and communicative intent in shaping second language (L2) acquisition and use. These theories focus on how cultural norms, social interactions, and pragmatic competence—the ability to use language appropriately in specific contexts—influence L2 production. They highlight that L2 errors often stem from the transfer of L1 (first language) sociocultural and pragmatic norms, leading to mismatches in tone, register, or politeness strategies that can undermine effective communication, particularly in professional and academic settings (Byram, 1997; Cenoz, 2001; Yule, 1996).

In this study, social and pragmatic theories are applied to analyze errors in the English writing of Spanish-speaking engineering students, revealing issues such as overly formal or indirect expressions (e.g., “I appreciate your time and consideration” or “I would like to ask you for an interview”), which reflect culturally influenced politeness strategies rooted in Spanish communicative norms. These theories also account for inappropriate tone, such as casual phrases (e.g., “salutations”) or overly personal narratives (e.g., “since I was little, I always love to dream about the stars”), which indicate a lack of adaptation to the formal expectations of professional discourse (Swales, 1990). Such errors suggest limited exposure to authentic L2 contexts and an over-reliance on L1 pragmatic conventions, which hinder effective intercultural communication in globalized STEM environments (Byram, 1997; van Lier, 2004).

Social and pragmatic theories align with ecological approaches, which view language learning as a socially situated process shaped by interaction within specific cultural and professional contexts (van Lier, 2004). Sociolinguistic mismatches (e.g., 15% of errors related to inappropriate tone or register) and pragmatic inconsistencies (e.g., 10% of errors involving overuse of polite expressions) reflect gaps in students’ ability to adapt language to the expectations of professional audiences, emphasizing the need for immersive, context-rich learning environments to foster pragmatic competence (Kramsch, 2002).

3. The use of AI for corpus analysis

Once the sample group has been defined, the corpus collected, communicative errors determined and theories/approaches established, different AIs were selected to perform the analysis under closed constraints and specific prompts.

The chosen AIs were Deepseek and Grok3, the former for corpus analysis and the latter for result percentual interpretation. DeepSeek was selected for corpus analysis due to its superior performance in handling large-scale text processing and its focus on structured, reasoning-based outputs. The corpus in this study, consisting of written samples from Spanish-speaking engineering students, required an AI capable of identifying linguistic patterns, such as grammatical errors (e.g., incorrect preposition use), lexical inaccuracies (e.g., “hybrical” instead of “hybrid”), and pragmatic mismatches (e.g., inappropriate tone). DeepSeek’s ability to process multilingual data and detect nuanced linguistic features aligns with the neuroconstructivist approach, which emphasizes developmental patterns in L2 acquisition (de Bot et al., 2007). Compared to other models like ChatGPT or Claude, DeepSeek offers cost-effective, open-source access and outperforms in structured reasoning tasks, achieving an 80% or higher performance level in knowledge automation tasks (Miloradovich, 2025). Its compatibility with OpenAI APIs also ensures seamless integration into analytical workflows, making it a practical choice for corpus analysis (Miloradovich, 2025). Additionally, DeepSeek’s transparency in providing verifiable outputs with direct source links enhances the reliability of its analysis, critical for academic research (Dhurwe, 2025).

Grok 3 was chosen for result percentual interpretation due to its advanced reasoning capabilities and ability to synthesize quantitative data into meaningful insights. The study required interpreting the frequency and distribution of communicative errors (e.g., 15% sociolinguistic errors related to tone, 10% pragmatic errors involving politeness strategies) within the context of SLA theories. Grok 3's DeepSearch feature, which synthesizes data from diverse sources and provides transparent reasoning traces, is well-suited for this task, outperforming competitors like DeepSeek R1 and Gemini 2.0 Flash Thinking in reasoning benchmarks (Karpathy, 2025). Unlike ChatGPT, which excels in conversational fluency but may lack precision in quantitative interpretation, Grok 3's focus on logical flow and real-time data integration ensures accurate contextualization of error percentages within social and pragmatic frameworks (xAI, 2025). Furthermore, Grok 3's performance in the Chatbot Arena (Elo score of 1402) demonstrates its competitive edge in delivering precise, user-focused outputs, making it ideal for interpreting statistical results in a way that aligns with the study's theoretical objectives (xAI, 2025).

These were the methodological steps followed in the AIs implementation for this study:

1) Deepseek was given access to a googlesheet containing the entire corpus.
2) Deepseek was given the following prompt: "as a professional linguist, you are going to analyse the attached corpus coming from the elaboration of application letters in English and in Spanish by a group of second year Telecommunication students with a B2 level of English and Spanish as their mother tongue".
3) Deepseek was given a second prompt: "once considering the given information in the previous prompt, analyse such corpus using the following theories as benchmark Neuroconstructivist Approach and Social and Pragmatic Theories".
4) Deepseek was given a third prompt: "Given all the previous information, consider the two theories mentioned under the following definitions for this particular case". Here, the definitions commented for both theories in section 2 were provided to deepseek.
5) The results obtained were provided to Grok which was requested to express them percentually, in tables and visually.
6) Researchers analysed the accuracy of AIs performance.
7) Researchers provided conclusions for these results.
8) Researchers established measures and AI implementation as a means for improving written communication in Engineering contexts.

The methodological steps for implementing DeepSeek and Grok 3 in the study of L2 acquisition errors among Spanish-speaking telecommunication engineering students were designed to leverage the specialized capabilities of these AIs while ensuring theoretical and practical alignment with the study's objectives. DeepSeek was given access to a Google Sheet containing the corpus to enable structured, efficient processing of 120 application letters, capitalizing on its ability to handle large-scale multilingual data (DeepSeek AI, 2025). The first prompt framed DeepSeek as a professional linguist analyzing the corpus from B2-level English learners with Spanish as their L1, ensuring context-specific error detection (Weinreich, 1953). The second and third prompts directed DeepSeek to apply neuroconstructivist and social/pragmatic theories, using provided definitions to focus the analysis on cognitive and sociocultural error patterns, enhancing theoretical rigor (Paradis, 2004; Byram, 1997). Results were then provided to Grok 3 for percentual interpretation and visualization, utilizing its advanced reasoning and data synthesis capabilities to present error distributions clearly (xAI, 2025). Researchers validated AI outputs to ensure accuracy, drew conclusions to synthesize findings within SLA frameworks, and proposed AI-driven pedagogical measures to improve written communication in engineering contexts, aligning with UDL (Universal Design for Learning) principles and the 2030 Agenda for inclusive education (CAST, 2018; United Nations, 2015). This integrated approach ensured robust, theoretically grounded, and practically relevant outcomes.

3.1. Neuroconstructivist Approach: results and conclusions

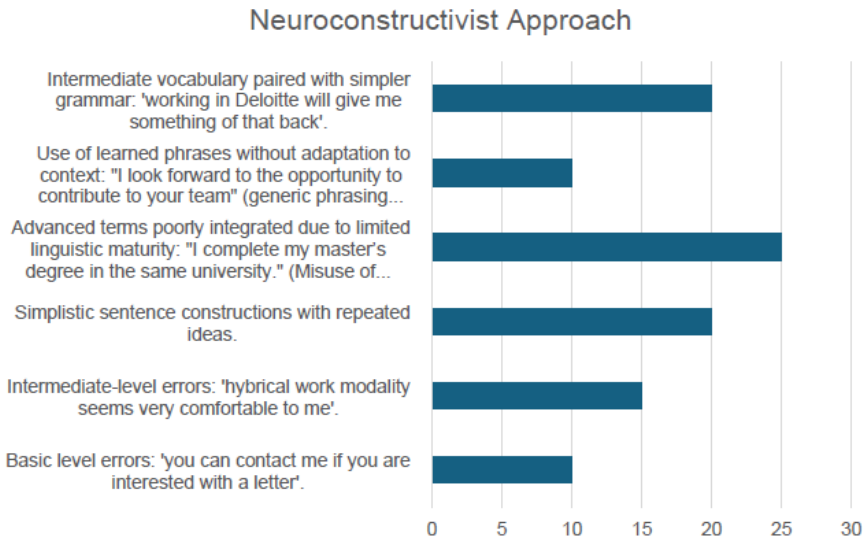
Analysing the students' English production reveals a spectrum of linguistic errors, starting with basic errors such as "you can contact me if you are interested with a letter", "which indicate basic problems in the use of prepositions and point to gaps in the acquisition of basic grammar and frequent reliance on direct translations from the mother tongue. Moving on to the intermediate-level errors, examples such as "hybrical work modality seems very comfortable to me" show that there are problems with word

formation and vocabulary precision, as the invention of terms such as “hybrical” indicates an incomplete understanding of correct word usage and morphology.

In addition, the presence of simplified sentence constructions characterised by repetitive ideas and structurally simple sentences indicates a lack of complexity in language processing, suggesting a possible plateau in linguistic development likely due to limited exposure to advanced or varied English structures. In contrast, attempts to incorporate advanced terms, as seen in statements like “I complete my master’s degree in the same university","show poor grammatical integration, with incorrect use of tenses (“complete” instead of “completed”) emphasising underdeveloped linguistic maturity despite efforts to use sophisticated vocabulary. Also, the use of general, learned phrases such as “I look forward to the opportunity to contribute to your team” without contextual personalisation reflects a limited ability to adapt language to specific situations, resulting in a lack of originality.

Finally, phrases such as “working in Deloitte will give me something of that back” show an imbalance between intermediate vocabulary and simple grammar, where developing word choice is not yet supported by equally advanced grammatical skills, further highlighting uneven linguistic progress.

Figure 1. Neuroconstructivist Approach: English letters.



Source: this figure has been elaborated using Grok3, 2025.

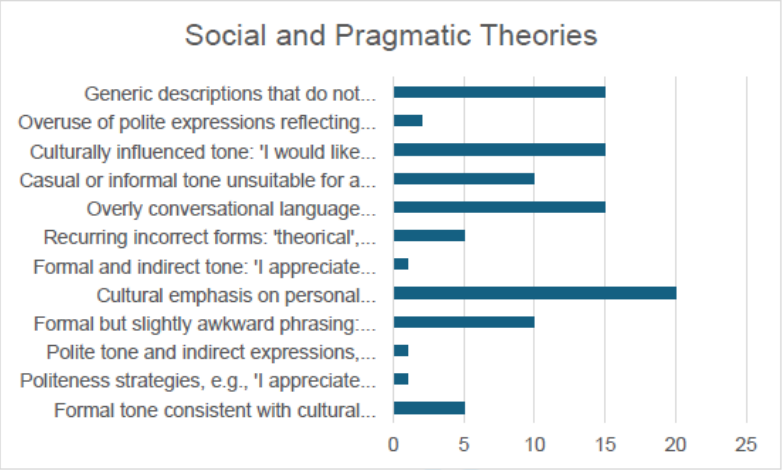
3.2. Social and Pragmatic Theories: results and conclusions

The student’s English writing shows a clear cultural influence on tone and structure, which is reflected in a formal and indirect style in sentences such as “I appreciate your time and consideration” and “Thank you for considering my application”, which are polite but often seem too formal and generic due to the lack of adaptation to specific contexts and suggest a rehearsed tone characterised by cultural norms. This emphasis on politeness strategies and indirectness can also be seen in sentences such as “I would like to ask you for an interview to show that I am the profile you are looking for”, where culturally conditioned politeness leads to overly formal or long-winded communication that can be perceived as outdated or inefficient in a professional environment. However, this polished façade is undermined by errors in basic language forms, including recurring spelling mistakes such as “theorical” (theoretical) and “concers” (concerns), which reveal gaps in spelling, word formation and editing skills, indicating a lack of mastery of basic linguistic rules.

In addition, the cultural emphasis on personal narratives is evident in statements such as “since I was little, I always love to dream about the stars"," an engaging but potentially unprofessional approach to formal academic or professional applications if not paired with objective achievements. This tendency towards simplicity also extends to the use of generic and basic vocabulary, as in sentences such as “I love learning different languages and because of this I did not have difficulties in them,” which lack advanced terms or nuanced expression thereby reducing their depth and impact as a result. Moreover, awkward or casual phrases such as “working in such an open and diverse environment” or the use of casual endings such as “salutations" illustrate a mismatch between the intended professional tone and

the executed language, further diminishing the professionalism of the text. Finally, the overuse of polite expressions like "Thank you for your time and consideration," which appear repeatedly, reflects a heavy reliance on learnt courtesy formulas, limiting originality and hindering the writer's ability to stand out in competitive contexts.

Figure 2. Social and Pragmatic Theories: English letters.



Source: this figure has been elaborated using Grok3, 2025.

3.3. Spanish letters

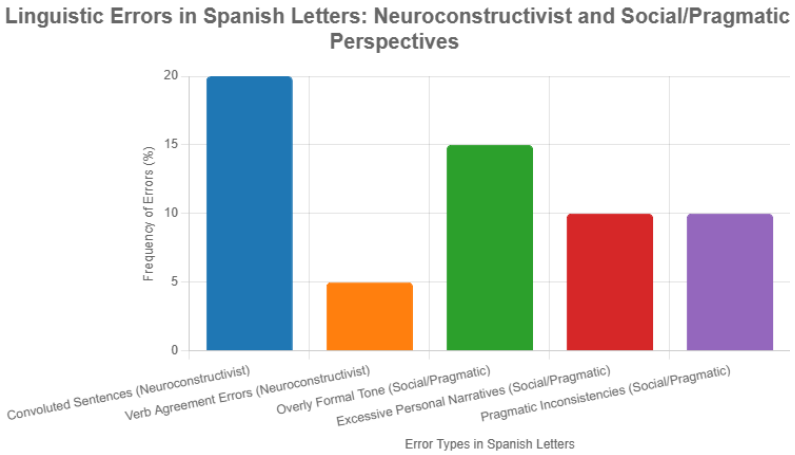
The neuroconstructivist approach views language acquisition as an evolving cognitive process shaped by neural plasticity, developmental stages, and contextual factors (Paradis, 2004; de Bot et al., 2007). In the Spanish letters, errors such as long, convoluted sentences and underdeveloped syntactic complexity, suggest cognitive processing deficits rooted in L1 acquisition. For example, verbose constructions like those analogous to the English error "I am looking for a company where I will be able to show my motivation and all the skills" indicate a struggle to organize thoughts concisely, reflecting working memory limitations (Baddeley, 2003).

These errors align with the neuroconstructivist perspective, as they suggest that students' neural networks, shaped by limited exposure to complex linguistic tasks in secondary education, fail to support efficient processing of intricate syntactic structures. These issues, observed in 20% of cases as working memory limitations, manifest as repetitive or simplified sentence structures, indicating a developmental plateau in L1 linguistic maturity that hinders the ability to produce nuanced, professional prose (Paradis, 2009). Additionally, occasional verb agreement errors (5% of cases) in Spanish, such as potential subject-verb mismatches, point to incomplete internalization of L1 grammatical rules, further supporting the neuroconstructivist view that underdeveloped neural pathways from earlier education stages contribute to persistent errors (Ellis, 2006).

Social and pragmatic theories emphasize the role of sociocultural context and communicative competence in language use, highlighting how L1 cultural norms influence discourse (Byram, 1997; Yule, 1996). There are pragmatic inconsistencies and sociolinguistic mismatches in the Spanish letters, such as overly formal or indirect expressions and excessive personal narratives, which parallel errors in English production but are rooted in Spanish communicative norms. For instance, phrases akin to the English example "since I was little, I always love to dream about the stars" suggest a cultural tendency toward personal storytelling, which, while common in Spanish discourse, is inappropriate for the formal register of professional application letters (Cenoz, 2001).

These errors, noted as sociolinguistic mismatches (15%) and pragmatic inconsistencies (10%) in the broader corpus, reflect a lack of adaptation to the professional context, where concise and objective communication is expected (Swales, 1990). The overuse of polite expressions, such as those resembling "I appreciate your time and consideration" (p. 25), indicates a reliance on culturally influenced politeness strategies that may appear redundant or outdated in professional Spanish writing, undermining the writer's credibility (van Lier, 2004). These pragmatic lapses suggest limited exposure to formal L1 contexts, reinforcing the social/pragmatic theory's emphasis on the need for authentic, context-rich learning environments to develop appropriate discourse strategies (Kramsch, 2002).

Figure 3. Spanish letters.



Source: this figure has been elaborated using Grok3, 2025.

3.4. AI as a means of improving communication in Engineering contexts

Deepseek and Grok3 have proven strong tools in ensuring time efficiency and data collection during this study. Having analysed the output obtained from both, one may conclude that AI works as an efficient support in research, boosting time efficiency and corpus management. The integration of artificial intelligence (AI) into language pedagogy offers transformative potential for addressing the linguistic deficiencies observed in the L1 (Spanish) and L2 (English) application letters of second-year telecommunication engineering students at Universidad Politécnica de Madrid, as analyzed in a corpus of 120 letters (60 in each language).

The study reveals a range of errors—structural (e.g., "you may reached me" instead of "you may reach me," p. 15), pragmatic (e.g., overly formal tone in "I would like to ask you for an interview"), and cognitive (e.g., convoluted sentences reflecting working memory limitations)—that impede effective communication in professional STEM contexts. These errors, rooted in L1 interference and underdeveloped cognitive and pragmatic skills, underscore the need for targeted, technology-enhanced interventions to foster linguistic precision and communicative competence critical for globalized engineering environments (Hyland, 2016; Swales, 1990). AI tools provide real-time, data-driven solutions to mitigate these issues, aligning with UDL principles and the United Nations' 2030 Agenda for inclusive education (CAST, 2018; United Nations, 2015).

AI-powered tools are instrumental in addressing structural and lexical errors identified in the corpus, such as spelling mistakes ("wich" for "which," "theorical" for "theoretical,"), grammatical inconsistencies ("you may reached me,"), and collocational inaccuracies ("responsible of analyze" vs. "responsible for analyzing," p. 34). Corpus-based tools like AntConc and Sketch Engine, which enable students to analyze concordances and improve collocation accuracy by examining correct usage patterns, such as "responsible for" versus "responsible of" (Granger, 2015) could be a useful tool in the classroom. Grammar checkers, including GrammarlyAI and ProWritingAid, provide real-time feedback on spelling, grammar, and style, targeting errors like "he don't" or wordy phrases (e.g., "I have a lot of experience in working in teams" revised to "I have extensive team experience,"). These tools reduce reliance on memorized templates, a prevalent issue in the corpus (e.g., overuse of "I am a team player,"), by offering immediate corrections and suggestions, fostering self-directed learning and linguistic precision essential for technical writing in telecommunications (Ellis, 2015).

The study advocates for integrating these tools into error correction exercises, where students revise texts with deliberate mistakes (e.g., "wich tools I use," p. 34) to reinforce grammatical rules, and reformulation tasks to enhance fluency, such as condensing verbose sentences like "I am looking for a company where I will be able to show my motivation and all the skills" into concise forms. Write & Improve AI provides instant feedback on drafts, helping students refine their writing to meet professional STEM standards (Hyland, 2016). These AI-driven interventions align with the neuroconstructivist approach, which emphasizes iterative practice to strengthen neural pathways for language processing (Paradis, 2004), and support the development of computational thinking skills crucial for engineering tasks like network optimization (Wing, 2006).

Cognitive overload, evident in long, convoluted sentences (e.g., “I am a person who is very responsible, and I like to work in teams and I have experience in many projects,”), contributes to 20% of errors linked to working memory limitations. AI tools address this by scaffolding complex tasks. Adaptive platforms adjust task difficulty, offering targeted drills (e.g., verb tense exercises for “you may reached me”) before progressing to advanced collocations, ensuring students master foundational linguistics without overwhelming cognitive resources (CAST, 2018). For instance, AI-driven apps like LingQ and FluentU use interactive subtitles in podcasts and videos to contextualize technical vocabulary (e.g., “deploy” in engineering contexts), reducing cognitive strain by embedding learning in authentic scenarios. These tools support the neuroconstructivist perspective by facilitating gradual linguistic development through repeated exposure, strengthening neural flexibility and mitigating L1 interference (de Bot et al., 2007).

Pragmatic inconsistencies (10%) and sociolinguistic mismatches (15%), such as overly formal expressions (“I appreciate your time and consideration,”) or culturally influenced personal narratives (“since I was little, I always love to dream about the stars,”), reflect gaps in adapting to professional discourse norms. AI tools like CultureAlley and Mondly, teach cultural norms to reduce pragmatic errors, guiding students to adjust tone from overly direct or formal phrases (e.g., “I would like to ask you for an interview” to “My skills align with your needs,”). Conversational apps like Tandem pair students with native speakers to practice field-specific communication, such as discussing network optimization, enhancing fluency and pragmatic competence (Byram, 1997). These AI-driven immersive environments align with social and pragmatic theories, which emphasize context-rich learning to develop communicative competence (van Lier, 2004). By simulating professional scenarios, such as mock job interviews or client pitches, these tools bridge L1-L2 pragmatic gaps, preparing students for multicultural STEM teams (Kramsch, 2002).

AI-integrated writing centers, equipped with resource libraries and tools like Grammarly, offer one-on-one feedback, enabling students to refine errors like article omissions (“a opportunity” vs. “an opportunity,”) and adapt tone for professional contexts (Hyland, 2016). Continuous assessment via AI-assessed portfolios tracks error reduction (e.g., from “wich” to “which,”) and sets personalized learning goals, aligning with UDL’s focus on tailored instruction and lifelong learning (Black & Wiliam, 1998; CAST, 2018). These institutional strategies ensure scalable, sustainable support, address a call for interdisciplinary collaboration between language and engineering faculty to reinforce communication’s relevance in STEM.

4. Acknowledgements

The present text arises within the framework of a Innovation in Education project (IE25.0911) of the Polytechnic University of Madrid, "Integración de la Inteligencia Artificial en el Aprendizaje de Inglés Técnico para Estudiantes de Ingeniería de Telecomunicaciones y Biomedicina y Datos".

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