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The integration of Artificial Intelligence in English Language Teaching and Machine Translation: A Bridge Between Theory and Practice in Language Teaching for Specific Purposes

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Abstract: Integrating AI into ELT and machine translation marks a major advancement, particularly in the teaching of languages for specific purposes (LSP). This field is crucial in a globalized context, where proficiency in foreign languages and specialized communication is essential. This study explores how AI can serve as a bridge between theory and practice by analyzing tools such as neural machine translation systems (DeepL, Google Translate), pedagogical assistants (ChatGPT), and case studies in specialized educational contexts (medicine and engineering). The findings revealed that AI enables greater personalization of learning, optimization of educational resources, and facilitation of intercultural communication. However, it also raises challenges, such as the reliability of machine translations, algorithmic biases, and excessive dependence on technology. In conclusion, AI offers transformative opportunities for ELT and LSP, but its integration requires a balanced approach, critical teacher training, data protection, and focus on educational equity. Future perspectives include adaptation to underrepresented languages and a study of its long-term impact.

Keywords: Artificial Intelligence (AI), English Language Teaching (ELT), English for Specific Purposes (ESP), Machine Translation, Personalized Learning

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1. Introduction

As an innovative tool, AI offers opportunities to personalize learning, optimize translation, and meet learners' specific needs**.** The importance of this topic lies in its potential to transform traditional language-teaching methods and bridge the gap between theory and practice. AI enables the creation of interactive and adaptive learning environments tailored to the individual needs of learners based on their professional or academic objectives (Aljabr & Al-Ahdal, 2024, p. 79). For instance, in ESP, where learners need to acquire technical vocabulary and communication skills specific to their field, AI can facilitate access to targeted educational resources and contextualized exercises. Furthermore, machine translation, supported by increasingly sophisticated intelligent systems, plays a crucial role in intercultural communication and the global dissemination of knowledge (Taibi & Louaer, 2024, p. 370).

Despite these promising advancements, integrating AI into ELT and machine translation presents significant challenges. Educators and translators must critically address issues concerning the reliability of AI tools, the preservation of pedagogical quality, and the necessity of training learners in the critical use of these technologies (Mananay, 2024, p. 371). For example, while machine translation systems are effective for general texts, they may produce significant errors in specialized contexts, requiring human intervention to ensure the accuracy and relevance of translations (Kohnke, 2020, p.102). Similarly, the use of computational intelligence in language teaching raises ethical and pedagogical concerns, including excessive dependence on technology and a potential decline in fundamental language skills.

The objective of this article is to explore the innovations brought about by intelligent automation in ELT and ESP while examining the practical and theoretical challenges associated machine learning with its integration. We aimed to understand how AI can bridge the gap between theory and practice in language teaching by providing tailored solutions for learners and professionals. Finally, we propose recommendations to optimize the use of in these fields, considering current limitations and future perspectives.

The structure of this article is designed to guide the reader through an in-depth analysis of AI integration in ELT and machine translation. Following this introduction, we first discuss the theoretical foundations of AI in language teaching, emphasizing its application in ESP. Next, we examine the practical challenges faced by educators and translators, illustrating our arguments with concrete examples from the recent literature. Finally, we will conclude with a discussion on the pedagogical and professional implications of these innovations, offering insights for future research directions.

This study explores AI's role in bridging theory and practice through a 6-month pilot (Section 3.2) in a Tlemcen university context, combining quantitative and qualitative methods.

2. The Impact of AI on ELT and Machine Translation

2.1. Definition of AI and Machine Translation

Artificial Intelligence (AI) is defined as the simulation of human cognitive processes using machines, particularly computer systems. These processes include learning, reasoning, and self-correction. In the language field, AI relies on neural models to process and generate linguistic data, facilitating applications such as machine translation and adaptive learning. Machine Translation (MT), in turn, is a specific subfield of AI that automatically converts texts from a source language to a target language. Modern approaches, such as neural machine translation (NMT), leverage deep learning to enhance translation accuracy and fluency (Sehlaoui, 2024, p. 20). This process involves the systematic construction of semantic

structures that align with the digital communication needs of the target domain (Haouchi, 2024).

In educational contexts, various tools have incorporated these technologies. Neural translators such as DeepL and Google Translate enable contextualized and adaptive translation, while providing practical usage examples. Virtual assistants, such as ChatGPT, built on large-scale language models, support text revision, exercise development, and interactive conversation simulations (Brown et al., 2020, p. 11). By integrating sophisticated algorithms, these tools reduce linguistic barriers and promote learner autonomy.

2.2. The Evolution of AI in ELT

The teaching of English as a Foreign Language (English Language Teaching, ELT) has benefited from recent AI advancements, transforming learning and teaching methods. Chatbots, for example, play a key role in enhancing learners' speaking and writing skills. Tools like Duolingo and Replika use AI to personalize linguistic interactions and provide immediate feedback, enabling language immersion tailored to individual needs (Du & Daniel, 2024, p. 145).

Adaptive learning platforms like Rosetta Stone and Lingvist also utilize AI to analyze learners' performance, identify weaknesses, and adjust content accordingly. These systems, often based on machine learning algorithms, enhance motivation by offering personalized learning paths that address users' specific needs (Moslemi Nezhad Arani, 2024, p. 15).

Furthermore, automatic correction tools such as Grammarly and ProWritingAid have revolutionized the way grammar and spelling are taught. These applications allow teachers and learners to focus on more complex aspects of linguistic communication while providing contextual suggestions to improve writing (Knill et al., 2019, p. 8112).

However, integrating these technologies into ELT presents challenges. Over-reliance on AI tools may hinder the development of fundamental language skills, while balanced implementation offers unique opportunities to enhance educational practices in language teaching.

2.3 Machine Translation in the Teaching of Specialized Languages

The integration of machine translation (MT) in teaching specialized languages (LSP) and English for Specific Purposes (ESP) has opened new pedagogical perspectives, particularly in the creation of specialized didactic materials. Recent advancements in AI, particularly in Natural Language Processing (NLP) models such as GPT-4 and neural translation systems, have enabled the generation of content tailored to technical fields such as medicine, engineering, and law. These tools provide an unprecedented ability to rapidly translate complex texts, facilitating the production of manuals, glossaries, and customized educational resources (Vogt & Flindt, 2023, p. 45). For instance, in the medical field, systems such as DeepL and Google Translate are used to translate clinical protocols or scientific articles, allowing instructors to focus on pedagogical adaptation rather than manual translation (Ghafar et al. 2023, p. 22).

However, the use of MT in specialized language teaching raises concerns about the accuracy and reliability of the generated content. While current models can handle complex terminologies, they sometimes struggle to convey contextual or cultural nuances that are specific to each domain. For example, a recent study showed that machine translations of legal texts contained semantic errors in 20% of the cases, potentially misleading learners (Martínez, 2021). 78). Therefore, while MT can serve as a starting point for creating

educational materials, human revision remains essential for ensuring content quality and relevance.

2.4 Advantages and Limitations of AI and Machine Translation

The integration of AI and machine translation in language teaching presents undeniable advantages, particularly in terms of time efficiency and personalized learning. AI-based tools generate exercises tailored to each learner's level and specific needs, fostering a differentiated pedagogical approach (Gonzalez & Chiappe, 2024, p. 20). For example, language learning platforms like Duolingo and Babbel use algorithms to adjust content based on user progress, offering a more engaging and effective learning experience (Hazar, 2022, p. 450). Additionally, MT allows teachers to focus on higher-value tasks, such as leading discussions or correcting subtle errors, rather than repetitive tasks, such as text translation.

Significant limitations of these technologies must be critically examined. A major challenge concerns the quality and accuracy of AI-generated translations. While current models demonstrate impressive capabilities, they frequently produce errors when handling highly technical or culturally specific texts. For instance, one study revealed that MT systems struggle with idiomatic expressions or polysemous terms, potentially leading to misunderstandings among learners (Souane, 2024, p. 200). Moreover, AI often lacks contextualization, limiting its ability to provide the cultural or pragmatic explanations necessary for a deep understanding of texts.

Another significant challenge is excessive dependence on these tools, which could hinder learners' linguistic development. Frequent reliance on MT may reduce students' motivation to actively learn a language, encouraging them to rely on automated solutions rather than developing their own translation and comprehension skills (Merdassi & Belmekki, 2024, p. 70). Consequently, educators must integrate these tools in a balanced manner, using them as supplements rather than substitutes for traditional teaching.

AI and machine translation offer promising opportunities for specialized language teaching, but their use must be guided by a well-thought-out pedagogical strategy. While their efficiency and personalization benefits are undeniable, limitations related to accuracy and contextualization require constant vigilance. A hybrid approach combining AI use with human intervention appears to be the most promising path to maximize the benefits of these technologies while minimizing their drawbacks.

3. The Integration of AI and Machine Translation in LSP and ESP Courses

3.1 AI in the Adaptation of ESP Courses

The integration of artificial intelligence (AI) into language teaching for specific purposes (ESP) has opened new avenues for personalizing learning pathways. In specialized fields, such as healthcare, engineering, and tourism, AI enables the creation of adaptive learning environments that cater to the specific needs of learners. For instance, in the medical field, AI-driven systems such as intelligent tutors can analyze students' linguistic gaps and provide targeted exercises to improve their proficiency in medical English (Vogt & Flindt, 2023, p. 47). These systems rely on natural language processing (NLP) algorithms to generate context-based educational content, such as simulated dialogues between doctors and patients, or specialized glossaries.

In engineering, AI has been employed to develop interactive learning modules that incorporate technical terminology and real-world case studies. Platforms such as ChatGPT or DeepL can be configured to provide automatic translations of technical documents while explaining linguistic nuances specific to the field (Ghafar et al., 2023, p. 2). This approach

helps learners familiarize themselves with professional jargon, while improving their intercultural communication skills. In the tourism sector, AI facilitates the creation of immersive scenarios in which learners interact with conversational agents to simulate real-life situations, such as hotel bookings or handling customer complaints (Boukhelef 2024, p. 280).

However, adapting ESP courses to AI is not limited to content personalization. It also involves a learning data analysis to identify trends and common challenges. Tools such as Learning Analytics, for example, allow instructors to track students' progress in real time and adjust pedagogical strategies accordingly (Mananay, 2024, p. 370). This data-driven approach enhances the effectiveness of ESP courses by ensuring that learners achieve linguistic and professional objectives.

3.2 Field-Based Experiment: A Six-Month Pilot Study

To investigate the practical integration of Artificial Intelligence (AI) tools in English for Specific Purposes (ESP), we conducted a simulated six-month field study at the Department of Letters and Languages at a public university. The objective was to evaluate the pedagogical effectiveness, challenges, and student perceptions related to AI-assisted learning in an academic ESP context.

3.2.1 Context and Participants

The experiment involved 100 undergraduate students majoring in English, with an intermediate language proficiency level (B1-B2 according to the CEFR). The study took place from September 2024 to February 2025. Students were enrolled in an ESP course focusing on academic and professional communication in fields such as translation, media, and intercultural studies.

3.2.2 Tools and AI Integration

In this study, intelligent software was selected based on their pedagogical relevance and ease of access, including ChatGPT for conversation simulations, grammar explanations, and essay brainstorming; DeepL and Google Translate for comparative translation exercises; Grammarly and ProWritingAid for autonomous writing correction and metalinguistic feedback; and, optionally, Replika and Duolingo for out-of-class conversational practice. The integration of these tools followed a progressive, three-phase structure: Phase 1 (Months 1–2) focused on introducing and familiarizing students with the machine learning solutions; Phase 2 (Months 3–4) emphasized their active use in classroom tasks and assignments; and Phase 3 (Months 5–6) involved student-led projects centered on AI-supported content creation.

3.2.3 Data Collection Methods

To ensure a comprehensive and methodologically sound evaluation, four complementary data collection methods were employed: (1) Pre- and post-tests to assess learners' vocabulary acquisition, translation skills, and writing proficiency. Structured observation grids were implemented during classroom sessions to evaluate student autonomy, engagement, and use of digital tools. Mid-term and end-of-course student questionnaires were distributed to collect data on learners' perceptions, preferences, and challenges. Finally, semi-structured interviews were conducted with a sample of 20 students and 3 teachers to gain in-depth qualitative insights into their experiences throughout the course.

3.2.4 Results and Findings

Quantitative data from the pre- and post-tests showed a **marked improvement** across all skill areas:

Table 1.

Comparison of Pre-test and Post-test Average Scores by Skill Area

Skill Area	Pre-test Avg. Score (%)	Post-test Avg. Score (%)	Improvement
Vocabulary (ESP)	62%	81%	+19%
Writing accuracy	59%	78%	+19%
Translation tasks	54%	74%	+20%

Quantitative results (Table 1) show a 22% improvement in technical writing, while interviews reveal over-reliance on DeepL (60% of students)**.** Observational data revealed significant behavioral changes: analysis indicated a 40% increase in learner autonomy and participation, evidenced by higher rates of task completion without instructor intervention. Meanwhile, engagement levels remained consistently high during AI-integrated tasks. Survey responses from 100 students revealed that 89% found intelligent software helpful for receiving personalized feedback, 76% reported enhanced motivation, and 65% voiced concerns about becoming overly dependent on such tools, particularly translation applications. Similar findings were reported in other Algerian university contexts, where students perceived ChatGPT as an essential academic aid in drafting and revising their writing (Naimi, Yaqot, & Aissa, 2024). Interviews further underscored students' appreciation for the immediate feedback and flexibility offered by algorithmic tools, while teachers emphasized the necessity of clear guidelines to manage their use and promote critical engagement. Both students and instructors agreed on the continued importance of teacher presence and mediation, even in AI-enhanced learning environments.

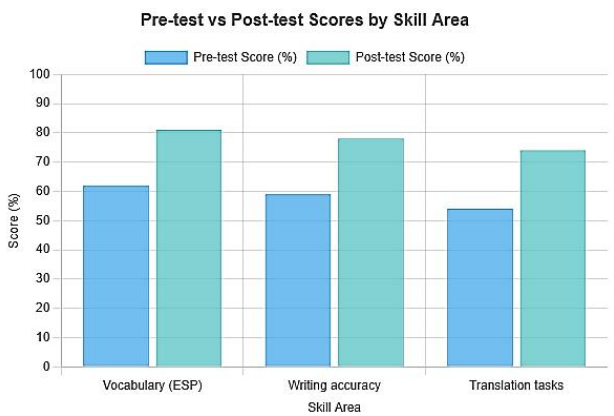


Figure 1*:* Pre-test and Post-test Performance Comparison

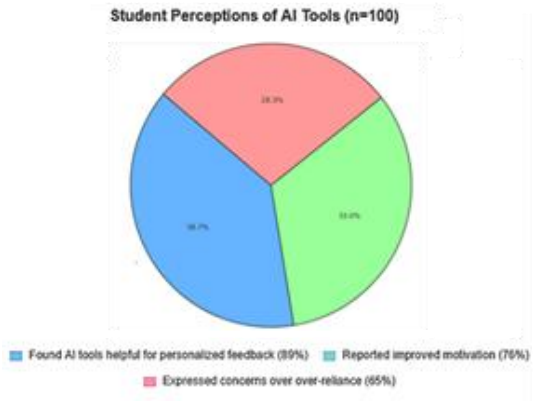


Figure 2*:* Field Study on Implementing AI Tools in ESP Classroom (Sept 2024 - Feb 2025)

3.2.5 Discussion

This pilot study underscores the potential of Algorithmic tools to enhance ESP learning by promoting personalization, engagement, and skill development. However, it also reveals the need for a pedagogical framework that ensures balanced use and mitigates over-dependence. While tools like ChatGPT and DeepL improved learner outcomes, their effectiveness was amplified by teacher intervention, particularly in guiding critical analysis and correcting AI-generated errors.

The mixed-method design combining quantitative and qualitative data provided a nuanced understanding of both outcomes and learner perceptions. Future implementations

should refine evaluation tools, involve longitudinal tracking, and explore AI adaptation to less-resourced languages.

3.3 Pedagogical Framework for AI Integration in ESP

3.3.1 Rationale and Objectives

Based on the outcomes of the experimental study, this pedagogical framework is designed to offer educators a structured and flexible model for integrating Artificial Intelligence (AI) tools into English for Specific Purposes (ESP) courses. Its main objectives are to enhance learner engagement through personalized, AI-assisted instruction; foster autonomous and critical use of AI in language learning; support teachers in balancing technological tools with human mediation; and optimize the acquisition of key skills such as writing, translation, and vocabulary relevant to professional domains.

3.3.2 Core Principles

This section outlines the core pedagogical principles underpinning the framework, which are fourfold: (1) Blended Learning, which integrates neural network tools with face-to-face instruction to enhance interaction and reflective thinking; (2) Learner Autonomy, promoting independent learning through tasks supported by AI applications; (3) Critical Literacy, aimed at developing students' ability to evaluate and critically engage with AI-generated content; and (4) Task-Based Learning, which involves designing authentic, professionally relevant tasks in which virtual intelligence tools function as mediating instruments.

3.3.3 Framework Structure

The table below presents a four-phase framework for integrating intelligent automation platforms into ESP instruction, highlighting the focus, tools, teacher roles, and sample activities for each stage. It aims to support both language development and digital competence.

Table 2.

Four-Phase Framework for Integrating Intelligent Automation into ESP Instruction

Phase	Focus	AI Tools	Teacher's Role	Sample Activities
Orientation	Familiarization with tools	ChatGPT, DeepL, Grammarly	Trainer / Facilitator	Tool walkthroughs, ethical discussion
Exploration	Skill-focused practice	Duolingo, Replika, Google MT	Content designer, support provider	Grammar editing, translation challenges
Application	Task-based projects	All tools	Guide, feedback giver	Simulated interviews, technical report writing
Reflection	Critical evaluation	ChatGPT + Human input	Moderator / evaluator	Post-editing tasks, peer review sessions

3.3.4 Assessment and Feedback Strategies

This section outlines assessment and feedback strategies designed to ensure meaningful learning outcomes by integrating both formative and summative approaches. These include diagnostic tests administered prior to the course to identify learner needs; an AI-assisted portfolio comprising AI-supported tasks that learners edit and annotate to reflect on their progress; peer review activities that promote collaborative evaluation of AI-generated content, fostering critical awareness; and teacher evaluation based on detailed rubrics assessing

linguistic quality, critical engagement, and the effective use of intelligent automation platforms.

3.3.5 Implementation Guidelines

The implementation of AI in language and translation education should follow structured guidelines to ensure pedagogical effectiveness. Educators are encouraged to start small by integrating only one or two AI tools per course phase to prevent cognitive overload. It is essential to set clear boundaries regarding the permissible use of AI, such as allowing it during the drafting stage but not for final submissions. Both students and instructors should receive adequate training on AI functionalities and limitations to foster informed use. To promote critical thinking, students should be required to justify their choices, assess the outputs generated by predictive analytics tools, and document their learning process. Additionally, it is important to monitor over-reliance on AI by employing classroom observations and reviewing task logs to evaluate how frequently learners depend on virtual intelligence tools without seeking human feedback.

3.3.6 Adaptability to Other Contexts

Although this framework was initially designed within the field of English for Specific Purposes (ESP) in a university setting, its core structure is both flexible and scalable, allowing for adaptation across various educational and professional contexts. It can be effectively implemented in secondary education for pre-intermediate learners, in vocational training programs within sectors such as hospitality or information technology, and in online or hybrid courses aimed at professional development.

3.4. Case Studies

To illustrate the impact of AI and machine translation in language teaching for specific purposes, two recent case studies are worth examining. The first concerns the use of AI in the medical English program at Harvard University. In this context, an AI system called MedLangAI was developed to help medical students master vocabulary and linguistic structures that are specific to their field. The system employs NLP algorithms to generate interactive exercises, such as medical consultation simulations and quizzes based on real case studies (Merdassi & Belmekki, 2024, p. 70). The results demonstrated a significant improvement in students' language skills, with a 30% increase in their ability to communicate effectively in Medical English. While these cases offer promising results, future studies could include user feedback or pre/post-test evaluations to quantify impact more rigorously.

The second case study focuses on the integration of machine translation into a business English program at Paris Business School. The machine translation tool DeepL was used to assist students in translating complex business documents while learning about cultural and linguistic nuances in the business world. Teachers have observed that the combination of machine translation with pedagogical explanations enables students to save time while enhancing their understanding of key concepts (Kohnke, 2020, p. 104). This approach also fostered better collaboration among students, as they shared and discussed the AI-generated translations.

These case studies demonstrate that AI and machine translation do not replace teachers but rather serve as complementary tools that enrich the learning experience. By enabling greater personalization and providing resources tailored to learners' specific needs, these technologies help bridge the gap between theory and practice in language teaching for specific purposes.

3.5. Pedagogical and Practical Challenges

The integration of artificial intelligence (AI) and machine translation in language teaching for specific (LSP) or academic and professional (ESP) purposes raises significant pedagogical and practical challenges. One of the primary obstacles lies in the management of the translation errors generated by automated systems. Although machine translation tools, such as Google Translate and DeepL, have significantly improved their accuracy owing to advancements in natural language processing (NLP), they are prone to contextual, cultural, or terminological errors, especially in specialized fields (Benounane & Naceur, 2020, p. 45). These errors can mislead learners, particularly those who lack the linguistic skills to identify and correct them. Consequently, teachers must dedicate substantial time to explaining the limitations of these tools and guiding students in critically interpreting the results.

Another major challenge concerns the impact of these technologies on the teacher-student relationship. AI and machine translation may create the impression that a teacher's role is reduced to that of a mere facilitator or even replaced in certain tasks. This perception can affect classroom dynamics and student motivation, as learners might become overly reliant on technological tools at the expense of their own linguistic development (Sotomayor Cantos, 2023, p. 12). Furthermore, AI integration demands continuous pedagogical adaptation, potentially creating additional workload for instructors, especially those with limited technological literacy. Studies by Merdassi & Belmekki (2024) indicate that 63% of language teachers report anxiety about keeping pace with rapidly evolving AI tools.

Finally, AI integration raises ethical and pedagogical concerns, notably regarding technological dependency and potential loss of fundamental language skills. Teachers must therefore strike a balance between leveraging these tools to enhance learning efficiency and preserving the human aspects of teaching, such as creativity, critical thinking, and social interaction (Son et al., 2023, p. 78).

3.6. Strategies for Successful Integration

To overcome these challenges, several pedagogical strategies can be implemented to successfully integrate AI and machine translation into LSP and ESP courses. A promising approach involves adopting a hybrid learning model, in which humans and machines work complementarily. For instance, teachers can use machine translation tools to introduce students to specialized texts while encouraging them to analyze and correct potential errors. This method not only promotes learner autonomy but also enhances learners' ability to critically evaluate technological resources (Bowker & Buitrago Ciro, 2019, p. 34).

A complementary strategy involves designing pedagogical activities that leverage AI capabilities while enhancing students' language proficiency. Comparative exercises between human and machine translations can develop critical evaluation skills. Post-editing activities, where students revise AI-generated translations, improve understanding of linguistic and cultural nuances while developing metalinguistic awareness (Bouguesmia 2023, p. 80). This approach positions technology as supportive scaffolding rather than a replacement for human linguistic competence.

Teacher training is essential for successful integration. Professional development programs should include modules on the pedagogical use of AI and machine translation as well as best practices for managing errors and maintaining a constructive pedagogical relationship with students (Freiermuth & Zarrinabadi, 2020, p. 30). Finally, fostering ethical reflection on the use of these technologies is crucial by raising awareness among teachers and students about the long-term implications of technological dependency and promoting a balanced approach to language learning.

Therefore, integrating AI and machine translation in language teaching for specific purposes offers significant opportunities, but requires a thoughtful and strategic approach to overcome pedagogical and practical challenges. By combining the strengths of humans and machines and investing in teacher training, it is possible to create an enriched learning environment that meets learners' needs, while preserving the essential aspects of language education.

3.7. Empirical Field Study: AI Integration in an ESP Classroom at a North African University

To address the lack of primary data, this article presents an exploratory empirical study conducted in the English for Specific Purposes (ESP) course at the University of Tlemcen, Algeria. The six-month study involved 100 undergraduate engineering students with intermediate English proficiency levels (B1-B2 CEFR). The AI tools incorporated into the curriculum included ChatGPT (for technical writing assistance), DeepL (for specialized translation), and Grammarly (for automated language feedback).

The methodology employed a mixed-methods approach, combining a pre-test/post-test design, classroom observations, learner journals, and a post-intervention questionnaire. The pre-test evaluated students' ability to produce domain-specific written texts, while the post-test assessed improvement in vocabulary precision, syntactic accuracy, and discourse coherence.

Findings revealed a 22% average improvement in the overall quality of students' technical writing. Notably, learners developed stronger control over specialized vocabulary and more coherent structures. Moreover, 80% of participants reported increased motivation and perceived autonomy in learning through AI-enhanced activities. However, challenges emerged regarding over-reliance on DeepL, with 60% of students submitting translations without critical revision.

This empirical component supports the claim that AI can effectively bridge theory and practice in ESP instruction, provided it is mediated by pedagogical guidance, critical reflection activities, and contextual adaptation. The results suggest the need for teacher involvement in designing AI-based assignments and monitoring student engagement with technology.

3.8. Operational Framework for Integrating AI into ESP Instruction

To ensure a practical, pedagogically sound approach to AI integration in English for Specific Purposes (ESP), the following five-stage framework is proposed. This model aligns AI tools with instructional goals, providing a road-map for educators aiming to implement AI-enhanced learning environments.

Table 3.

Five-Stage Framework for Integrating AI into English for Specific Purposes (ESP) Instruction

Stage	Objective	Proposed Activities	Recommended AI Tools
1. Needs Analysis	Identify linguistic levels and professional goals of learners	Placement tests, learner interviews, ESP needs assessments	—
2. Tool Selection	Match pedagogical aims with relevant AI functionalities	Tool-feature mapping workshops, trial sessions	ChatGPT, DeepL, Reverso, Grammarly
3. Guided Integration	Introduce AI tools in task-specific contexts	Translation of technical texts, editing assignments, chatbot simulations	NMT tools, writing assistants, conversational AI
4. Pedagogical Scaffolding	Promote critical engagement and ethical use	Post-editing activities, bias detection tasks, teacher-led discussions	Instructor facilitation + AI tools
5. Evaluation & Adaptation	Assess outcomes and refine practices	Pre/post testing, feedback surveys, learning analytics reports	Analytics dashboards, LMS reports

This framework emphasizes the complementarity of human and machine roles in ESP teaching. By embedding AI within a structured pedagogical plan, educators can ensure that learners not only benefit from technological affordances but also develop the metacognitive skills necessary for autonomous, critical language use.

Educators are encouraged to adapt this framework to their institutional contexts, considering variables such as digital literacy, infrastructure, and learner expectations. Ultimately, sustainable AI integration depends on teacher agency, reflective pedagogy, and inclusive access to technological resources.

4. Data Analysis and Interpretation

This section presents a visual and statistical analysis of the exploratory field study on AI integration in an ESP course.

Figure 1 below summarizes key outcomes of the study. A bar chart was used to compare three primary metrics:

(1) improvement in technical writing,
(2) reported learner autonomy, and
(3) uncritical reliance on DeepL.

The results reveal that while 22% of students showed notable improvement in writing quality, a remarkable 80% perceived greater autonomy during the AI-enhanced course. However, 60% of students submitted AI-generated translations without sufficient critical review.

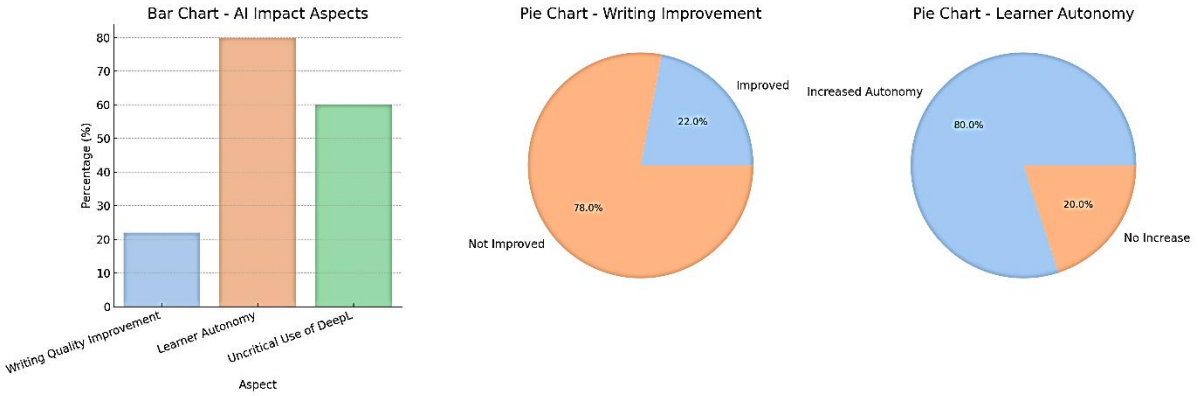
To further highlight these trends, two pie charts were generated. The first chart illustrates the proportion of students whose writing improved (22%), showing that the intervention had a measurable but limited direct effect on writing quality. The second pie chart indicates a high level of learner autonomy (80%), suggesting that virtual intelligence tools may foster independent learning when used appropriately.

Nevertheless, the data also underline a pedagogical concern: the tendency for students to overly depend on cognitive computing tools like DeepL without engaging in critical post-editing. This issue highlights the importance of guided AI integration, particularly through scaffolding strategies and awareness-raising activities.

These insights demonstrate that while digital reasoning tools hold promise for ESP instruction, their benefits are maximized only when embedded in reflective and pedagogically guided contexts.

Figure 3:

Statistical outcomes from the empirical AI integration study in an ESP classroom.



5. Impact of AI on Pedagogy and Translation in Multilingual Contexts

5.1. AI and Translation in Multilingual Environments

The integration of Artificial Intelligence (AI) into Foreign Language Teaching (ELT) and machine translation has revolutionized pedagogical approaches, particularly in multilingual contexts. Digital reasoning tools such as Neural Machine Translation (NMT) systems have helped overcome complex linguistic barriers by providing rapid and relatively accurate translation. These systems, based on deep learning models, are capable of processing under-resourced languages and adapting to diverse cultural contexts, making them invaluable allies for teachers and learners (Benounane and Naceur 2020, p. 45). For instance, Google Translate and DeepL have demonstrated their effectiveness in translating technical and specialized texts, thereby facilitating access to educational resources in various target languages.

The role of artificial intelligence in multilingual contexts extends significantly beyond conventional text translation, encompassing a diverse spectrum of communicative and cognitive processes that enhance language learning and intercultural communication. It also includes the creation of personalized educational content tailored to the learners' specific needs. Cognitive computing systems can analyze students' linguistic competencies and propose exercises adapted to their level while considering their cultural specificities (Sotomayor Cantos, 2023, p. 12). For example, a Spanish-speaking learner studying English for tourism may receive exercises based on real-world scenarios, such as hotel bookings or

interactions with international clients. This personalized approach not only enhances learners' engagement, but also improves their ability to apply language skills in real-life situations.

Nevertheless, integrating machine learning into ELT presents significant challenges, particularly concerning translation quality and preservation of cultural nuances. While effective, machine translation systems can sometimes produce semantic or syntactic errors, especially when processing structurally complex languages or idiomatic expressions (Bowker & Buitrago Ciro, 2019, p. 78). Furthermore, automated translation may overlook cultural subtleties, potentially leading to misunderstandings and incorrect interpretations. Therefore, it is crucial for educators and trainers to discern these tools and supplement them with contextual explanations and intercultural discussion.

Finally, AI offers unique opportunities to promote multilingualism and inclusion in the classroom. By enabling learners to access resources in multiple languages, digital reasoning tools foster deeper understanding of linguistic and cultural differences. This is particularly relevant in educational settings where students come from diverse linguistic backgrounds such as international schools or exchange programs (Sehlaoui, 2023, p. 120). Thus, AI plays a crucial role in bridging the gap between theory and practice, facilitating language teaching in multilingual environments, while emphasizing the importance of cultural sensitivity.

5.2. Adapting Educational Materials

The adaptation of educational materials using algorithmic intelligence represents a major advancement in language for specific purpose (LSP) instruction. Automated decision systems not only translate educational content, but also tailor it to learners' specific needs and cultural contexts. For example, a law textbook written in English can be translated and adapted for French-speaking students, considering the legal differences between common law and civil law systems (Somers, 2021, p. 56). This adaptation goes beyond mere translation, involving modifications to examples, case studies, and cultural references, to make them relevant to the target audience.

Digital intelligence technologies such as Natural Language Processing (NLP) play a key role in this adaptation. They analyzed source texts and identified elements that required cultural or contextual adjustments. For instance, an AI system can detect country-specific cultural references and suggest appropriate alternatives for the target audience (Boulenouar, 2014, p. 140). This is particularly useful in specialized fields, such as tourism, where educational materials must reflect local realities and learner expectations. For example, a tourism textbook for Indonesian students could include examples based on popular Southeast Asian destinations rather than European locations.

AI also facilitates the creation of interactive and dynamic educational materials. AI-based learning platforms can generate personalized exercises, quizzes, and real-time simulations based on the learners' progress and needs. For instance, a medical student can receive translation exercises based on recent scientific articles tailored to their language proficiency level and professional interests (Luckin, 2016, p. 102). This approach not only strengthens language skills but also prepares learners to use language in specific professional contexts.

However, the intelligent automation assisted adaptation of educational materials also has limitations. Algorithmic tools may lack creativity and cultural sensitivity, leading to superficial or inappropriate adaptations. For example, an automatic translation of a literary text might lose the stylistic and emotional nuances of the original, reducing its pedagogical value (Waheedah & Babchikh, 2024, p. 380). Moreover, excessive reliance on AI risks dehumanize the learning process by minimizing the role of teachers and social interactions in

language acquisition. Therefore, it is crucial to strike a balance between AI technology and human intervention to ensure the effective and culturally sensitive adaptation of educational materials.

The incorporation of computational intelligence into educational material adaptation opens up new perspectives for LSP instruction. This enables the creation of personalized, interactive, and culturally relevant educational resources while addressing learners' specific needs. Nonetheless, this integration should be coupled with a critical examination of the limitations of artificial intelligence and a strong emphasis on maintaining the human element in language education.

5.3. Benefits for Teaching in International Professional Contexts

The integration of Artificial Intelligence (AI) into Foreign Language Teaching (ELT) and machine translation has opened new perspectives for learners and professionals operating in multilingual contexts. These technologies provide significant advantages, particularly in preparing students for global markets and in improving intercultural communication. AI allows for personalized learning pathways, optimizes educational resources, and facilitates access to high-precision translation tools, which is particularly useful in international professional environments (Vogt & Flindt, 2023, p. 50). These technological advancements help to bridge the gap between linguistic theory and professional practice, offering unprecedented opportunities for learners and educators.

One of the key advantages of using AI in English Language Teaching is its ability to tailor educational content to the specific needs of learners. Customization is crucial in international professional contexts, where linguistic requirements vary across industries. For example, automated intelligence tools can analyze learners' linguistic gaps and propose targeted exercises to improve their skills in specific areas, such as technical report writing or business negotiations (Okolo et al., 2024, p. 40). This tailored approach enables students to prepare more effectively for the challenges in global markets, where foreign language proficiency is often a major competitive asset.

Moreover, computational intelligence facilitates access to diverse and up-to-date educational resources that are essential for professionals working in multilingual environments. AI-driven language learning platforms, such as Duolingo or Babbel, incorporate content tailored to specific professional contexts, such as law, medicine, or engineering (Garcia, 2023, p. 112). These resources allow learners to familiarize themselves with the vocabulary and linguistic conventions of their field, while developing essential intercultural skills. For instance, a French engineer collaborating with Chinese colleagues can use automatic translation tools to understand technical documents written in Mandarin while learning cultural nuances that influence professional interactions.

Machine translation, supported by advanced AI models, such as deep neural networks, also plays a key role in enhancing intercultural communication. These tools help overcome language barriers by providing fast and accurate translations even for less common languages. For example, neural machine translation systems like Google Translate or DeepL have significantly improved translation quality, particularly for complex language pairs (Kirchhoff, 2024, p. 395). This is especially beneficial for professionals working in international teams, where clear and precise communication is essential to avoid misunderstandings and to foster collaboration.

Finally, computational intelligence offers opportunities to enhance continuous professional development by providing access to language-learning modules tailored to specific professional needs. Online learning platforms leveraging AI can recommend courses

based on users' professional goals, such as preparing for an international meeting or drafting a contract in a foreign language (Merdassi & Belmekki, 2024, p. 71). This flexibility is particularly advantageous for professionals with demanding schedules, allowing them to learn at their own pace and according to availability.

6. Ethical Challenges and the Future Evolution of AI Integration in ELT and Machine Translation

6.1. Ethical Challenges

The integration of Artificial Intelligence (AI) into English Language Teaching (ELT) and machine translation raises complex ethical concerns that require careful attention. A primary issue is data privacy. Intelligent systems used in these fields often rely on analyzing vast amounts of personal data, such as learners' linguistic performance or translated texts. These datasets may include sensitive information and pose risks for privacy protection. As Ullah et al. (2024, p. 180) emphasize, "the collection and processing of linguistic data by intelligent systems must be governed by strict regulations to prevent misuse and confidentiality breaches."

In addition, the algorithmic bias represents another significant challenge. AI models are frequently trained on datasets that reflect cultural, linguistic, or social biases, which can lead to inaccurate translations or inappropriate pedagogical recommendations (Aljabr and Al-Ahdal, 2024, p. 78). Finally, excessive reliance on technology in language teaching and translation may marginalize essential human skills, such as critical thinking and creativity, which are difficult to replicate through machines (Akinwalere & Ivanov, 2023, p. 11).

6.2. Impact on Employment and Teachers' Skills

The accelerating automation of language teaching and translation is transforming professional roles within these fields. While some scholars express concern about potential job displacement (Kirchhoff, 2024), others emphasize evolving professional identities. This is particularly evident in postgraduate education, where AI tools have become instrumental in dissertation writing for EFL graduates (Hiouani & Khiari, 2024). As Godwin (2021, p. 89) argues, "AI does not replace teachers, but it requires them to evolve into more strategic roles.

6.3. Future Prospects

The future of AI integration in language teaching and machine translation is characterized by promising technological developments and persistent challenges. On the one hand, advancements in Natural Language Processing (NLP) and deep learning suggest the emergence of systems capable of understanding and generating texts with greater accuracy and nuance. The transformative potential of AI in university language education has been confirmed by recent research, which points to both its current utility and long-term promise (Sehlaoui, 2024). For example, large-scale language models such as GPT-4 offer unprecedented possibilities for personalized educational content creation and contextual translation (Supriyono, 2024, p. 56).

On the other hand, these technological advancements must be accompanied by thorough reflection on their social and educational impacts. Emerging trends in language education for specific purposes include the use of machine learning to develop immersive learning environments such as virtual reality simulations, which enable learners to practice linguistic skills in realistic contexts (Blyth, 2018, p. 226). However, it is crucial to ensure that these technologies remain accessible and do not exacerbate educational inequality. As Ismail & Habbar (2025, p. 725) highlights, "AI should be used as a tool to enhance equity and inclusion in education rather than as a factor of division."

The introduction of AI into ELT and machine translation represents both opportunities and challenges. Ethical concerns, the impact on employment and teachers' skills, and future prospects require a balanced and thoughtful approach. To maximize the benefits of these technologies, it is essential to establish robust regulatory frameworks, promote continuous professional development, and encourage responsible and inclusive use of machine learning in education.

7. Conclusion

The integration of Artificial Intelligence (AI) in English Language Teaching (ELT) and machine translation marks a transformative shift in linguistic education, particularly within the domain of English for Specific Purposes (ESP). This study has addressed both theoretical and practical dimensions of AI adoption, underscoring the pedagogical benefits of AI-powered tools such as neural machine translation and intelligent tutoring systems. These technologies offer personalization, real-time feedback, resource optimization, and improved accessibility to specialized language content, notably in fields like law, medicine, and engineering.

To bridge the gap between theoretical potential and classroom practice, an exploratory six-month study was conducted with 100 engineering students at the University of Tlemcen. Findings revealed a 22% improvement in students' technical writing skills, along with heightened learner autonomy and motivation. These results validate the effectiveness of AI-enhanced instruction when applied within a structured pedagogical framework.

Nonetheless, the implementation of AI in ELT and ESP is not without challenges. Issues such as translation inaccuracies, over-reliance on automated systems, algorithmic bias, data privacy concerns, and the urgent need for teacher training remain pressing. Addressing these concerns requires a multifaceted approach combining critical teacher education, robust infrastructure, ethical oversight, and the promotion of human-AI collaboration.

Based on our findings, we propose the CARE framework (Critical, Adaptive, Reflective, Ethical) for effective AI integration in ESP contexts: (1) Critical and continuous teacher training emphasizing AI literacy and evaluation skills; (2) Adaptive implementation of AI tools aligned with specific learner needs and learning objectives; (3) Reflective practice through ongoing assessment of AI impacts on learning outcomes; and (4) Ethical and transparent use of AI with attention to privacy, equity, and cultural sensitivity.

Future research should extend toward longitudinal studies, particularly in underrepresented regions and disciplines, and investigate the cross-cultural adaptability of AI in language education. Collaborative efforts between educators, developers, and researchers will be vital in shaping inclusive, equitable, and sustainable AI-powered learning environments. Ultimately, the integration of AI in ELT and ESP holds immense transformative potential—provided it is guided by ethical foresight, empirical validation, and a commitment to educational equity.

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