The Effect of Task-Based Learning on Enhancing Technical English Communication among IT Students: An Experimental Study

Presented by

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Abstract

This paper investigates the critical role of English for Specific Purposes (ESP) and Task-Based Language Teaching (TBLT) in enhancing the communication skills of IT students. It addresses the challenges faced by these students in technical communication and proposes a framework for effective language instruction. Drawing upon recent research, including the integration of AI tools like ChatGPT in TBL environments, this study aims to provide a comprehensive understanding of current pedagogical approaches and their impact on learning outcomes. The research further explores the application of schema theory and cognitive load theory to optimize the learning process in technical English contexts. Through a mixed-methods approach, this study evaluates the effectiveness of a task-based ESP curriculum in improving students' professional communication skills, including technical vocabulary acquisition and oral presentation. The findings highlight the importance of human oversight in AI-assisted learning and the need for tailored instructional strategies to address specific linguistic and cognitive challenges. This paper concludes with recommendations for future research and practical implications for ESP practitioners in IT education.

Keywords: Academic Writing, AI in Education, Cognitive Load Theory, English for Specific Purposes, IT Education, Schema Theory, Task-Based Language Teaching, Technical Communication

1. Introduction

In an increasingly interconnected and technologically driven world, the ability to communicate effectively in English, particularly within specialized technical domains, has become paramount. For students pursuing careers in Information Technology (IT) and related engineering fields, proficiency in English for Specific Purposes (ESP) is not merely an academic requirement but a critical professional competency. This paper delves into the multifaceted role of ESP and Task-Based Language Teaching (TBLT) in equipping IT students with the necessary communication skills to navigate complex technical landscapes.

1.1 The Critical Role of English Communication in Information Technology Education

The rapid evolution of information technology necessitates a workforce capable of not only understanding intricate technical concepts but also articulating them clearly and precisely. Whether it involves collaborating on international projects, documenting software specifications, presenting research findings, or engaging with global clients, effective English communication is the bedrock of success in the IT sector. Traditional English language instruction often falls short in addressing the unique linguistic demands of technical fields, leading to a gap between general language proficiency and the specific communication needs of IT professionals. This gap underscores the critical importance of specialized language programs that focus on the practical application of English in real-world IT contexts.

1.2 The Challenge of Technical Communication in English as a Foreign Language (EFL) Contexts

For IT students in English as a Foreign Language (EFL) environments, the challenges of technical communication are compounded. Beyond the complexities of mastering general English grammar and vocabulary, these students must contend with specialized terminology,

discipline-specific discourse conventions, and the nuances of conveying precise technical information. Academic writing, in particular, presents a significant hurdle, as it requires adherence to specific structural, stylistic, and citation guidelines, such as APA style. Furthermore, the cognitive load associated with processing new technical concepts in a foreign language can impede comprehension and effective communication. Addressing these challenges requires pedagogical approaches that are tailored to the unique needs of EFL learners in technical disciplines.

1.3 Task-Based Language Teaching (TBLT): A Framework for Technical Communication Development

Task-Based Language Teaching (TBLT) offers a robust pedagogical framework for developing technical communication skills in ESP contexts. Unlike traditional methods that prioritize grammatical accuracy in isolation, TBLT focuses on the completion of meaningful tasks that simulate real-world communication scenarios. This approach encourages learners to use language authentically to achieve a specific outcome, thereby fostering both fluency and accuracy. In the context of IT education, TBLT can involve tasks such as writing technical reports, delivering project presentations, participating in simulated client meetings, or debugging code collaboratively. By engaging in such tasks, students develop not only their linguistic proficiency but also their critical thinking, problem-solving, and collaborative skills, which are essential for success in the IT industry.

1.4 Gaps in Existing Research

While the benefits of ESP and TBLT are widely acknowledged, there remain specific gaps in the existing research, particularly concerning their optimal implementation and impact on IT students in diverse EFL contexts. There is a need for more empirical studies that investigate the long-term effects of TBLT on the comprehensive communication skills of IT students, including their ability to produce technical documents that demonstrate originality and avoid plagiarism. Furthermore, the integration of emerging technologies, such as Artificial Intelligence (AI) tools like ChatGPT, into TBLT environments for ESP warrants further investigation. While some studies have explored the use of AI in academic writing, there is a need for a deeper understanding of its implications for originality, creativity, and the development of higher-order writing skills in technical communication.

1.5 Study Objectives and Hypotheses

This study aims to address the identified research gaps by investigating the effectiveness of a task-based ESP curriculum in enhancing the professional communication skills of IT students in an EFL context. Specifically, the objectives of this study are to:

1. Evaluate the impact of a TBLT-based ESP curriculum on IT students' technical vocabulary acquisition and overall English proficiency.
2. Assess the improvement in IT students' academic writing skills, including their ability to produce well-structured, coherent, and grammatically accurate technical documents.
3. Examine the role of AI tools, such as ChatGPT, in facilitating or hindering the development of original and creative technical writing.
4. Investigate the perceptions of IT students regarding the effectiveness of TBLT and AI tools in their technical communication development.

Based on these objectives, the following hypotheses are proposed:

- **H1:** IT students exposed to a TBLT-based ESP curriculum will demonstrate significantly greater improvement in technical vocabulary and overall English proficiency compared to those in a traditional language learning environment.
- **H2:** The implementation of a TBLT-based ESP curriculum will lead to a significant improvement in IT students' academic writing skills, particularly in the production of technical documents.
- H3: While AI tools may assist in initial drafting and idea generation, their unsupervised use will result in a measurable decrease in originality and creativity scores in students' technical writing, as evaluated by a standardized rubric.
- **H4:** IT students will perceive TBLT as an effective approach for developing their technical communication skills, but will also acknowledge the need for critical evaluation and human refinement of AI-generated content.

1.6 Methodological Innovation

This study employs a mixed-methods approach, combining quantitative and qualitative data collection techniques to provide a comprehensive understanding of the research questions. The quantitative component involves pre- and post-tests to measure improvements in English proficiency and technical vocabulary, as well as rubric-based assessments of academic writing quality. The qualitative component includes surveys, interviews, and focus group discussions to gather insights into students' perceptions, challenges, and strategies in technical communication. A key methodological innovation is the inclusion of a quasi-experimental design with matched comparison groups to assess the impact of AI tools on writing originality and creativity, providing a nuanced perspective on the role of technology in language learning.

1.7 Theoretical and Practical Implications

This research has significant theoretical and practical implications. Theoretically, it contributes to the existing body of knowledge on ESP, TBLT, and the integration of AI in language education, particularly within technical domains. It aims to refine our understanding of how schema theory and cognitive load theory can be applied to optimize the learning of technical English. Practically, the findings will inform the development of more effective ESP curricula and instructional strategies for IT students. The insights gained from this study will assist educators in designing tasks that promote authentic communication, manage cognitive load, and leverage technology responsibly to enhance learning outcomes. Furthermore, the research will provide guidance to students on how to utilize AI tools ethically and effectively to support their academic and professional writing endeavors.

1.8 Conclusion

This introductory section has outlined the critical need for specialized English communication skills in the IT sector, the challenges faced by EFL learners in technical contexts, and the potential of TBLT as a pedagogical solution. It has also highlighted existing research gaps and presented the objectives, hypotheses, and methodological approach of this study. The subsequent sections will delve deeper into the literature review, methodology, results, and discussion, ultimately providing a comprehensive analysis of the role of ESP and TBLT in fostering effective technical communication among IT students.

2. Literature Review

This section provides a comprehensive review of the theoretical foundations and empirical studies relevant to English for Specific Purposes (ESP), Task-Based Language Teaching (TBLT), and their application in enhancing technical communication skills, particularly for IT students. It also explores the cognitive theories underpinning language acquisition in specialized domains and the emerging role of artificial intelligence (AI) in academic writing.

2.1 Theoretical Foundations of Schema Activation in Reading Comprehension

Effective reading comprehension, especially of technical texts, is not merely a decoding process but an active construction of meaning. This process is profoundly influenced by a reader's prior knowledge and cognitive structures, often referred to as schemata. Schema theory and cognitive load theory provide crucial insights into how learners process, organize, and retain information in specialized language contexts.

2.1.1 Schema Theory: Historical Development and Core Principles

Schema theory, a cognitive theory developed by Frederic Bartlett in the 1930s and later elaborated by Rumelhart and Ortony in the 1970s, posits that all knowledge is organized into abstract mental structures called schemata [2]. These schemata represent our generalized knowledge about objects, events, and situations, derived from past experiences. When individuals encounter new information, they attempt to integrate it into their existing schemata. If a relevant schema is activated, comprehension is facilitated; if not, or if the new information contradicts existing schemata, comprehension can be hindered or lead to misinterpretations [2].

In the context of language learning, schemata are categorized into three main types [17]:

- **Linguistic Schema:** This refers to a reader's knowledge of vocabulary, grammar, and syntax. For IT students, this includes general English proficiency as well as specialized technical jargon.
- **Content Schema:** This encompasses the reader's background knowledge about the subject matter of the text. For technical communication, this involves understanding IT concepts, systems, and processes.
- **Formal Schema:** This relates to the reader's knowledge of the rhetorical organization and structure of different text types. In technical writing, this includes familiarity with the conventions of research papers, technical reports, user manuals, and other genre-specific structures.

The activation of these schemata is crucial for effective reading comprehension. Pre-reading activities that activate prior knowledge, such as brainstorming, discussions, and vocabulary pre-teaching, have been shown to significantly improve comprehension, particularly for second language learners [11]. For instance, a study by Ardika et al. (2022) demonstrated that implementing schema activation strategies improved reading comprehension among polytechnic students [10].

2.1.2 Cognitive Load Theory and Schema Optimization

Cognitive Load Theory (CLT), proposed by John Sweller, is an instructional theory that focuses on the limitations of working memory and how instructional design can optimize

learning by managing cognitive load [5]. Cognitive load refers to the total amount of mental effort being used in the working memory. Sweller identified three types of cognitive load [5]:

- **Intrinsic Cognitive Load:** This is the inherent difficulty of the learning material itself, determined by the complexity of the information and the interactivity of its elements. For example, understanding a complex algorithm in IT has a high intrinsic load.
- **Extraneous Cognitive Load:** This is the mental effort imposed by the instructional design that is not directly relevant to learning. Poorly designed materials, confusing instructions, or irrelevant information can increase extraneous load, diverting cognitive resources away from learning.
- **Germane Cognitive Load:** This is the desirable mental effort involved in processing information and constructing schemas. It is the productive load that contributes to deeper understanding and the automation of knowledge in long-term memory.

In technical communication, the goal is to minimize extraneous load, manage intrinsic load, and optimize germane load. For ESP instruction in technical fields, this means designing learning materials and tasks that reduce unnecessary mental effort, allowing learners to focus on the essential concepts and build robust schemata. For example, a study on cognitive-based ESP instruction in oil and gas engineering highlighted the importance of understanding working memory and cognitive load to enhance specialized vocabulary acquisition [1]. Strategies such as clear and concise language, visual aids, and scaffolding can help reduce extraneous load and facilitate the development of germane load, thereby improving the learning of complex technical concepts [3].

2.2 Schema Activation Strategies: Evidence Across Educational Contexts

The application of schema activation strategies has demonstrated effectiveness across various educational contexts, including general education, English as a Foreign Language (EFL) settings, and emerging STEM education.

2.2.1 General Education Applications

In general education, schema activation is a widely recognized strategy for improving reading comprehension. Teachers often employ techniques such as KWL (Know-Want to Know-Learned) charts, pre-reading questions, and concept mapping to help students connect new information with their existing knowledge. Research consistently shows that activating students' prior knowledge before reading significantly enhances their understanding and retention of text [11]. For instance, a study on schema activation strategy in reading comprehension found that it successfully improved students' interest and understanding [1].

2.2.2 EFL Contexts: Insights for Arabic-Speaking Engineering Students

In EFL contexts, particularly for Arabic-speaking IT students, schema activation becomes even more critical due to potential linguistic and cultural differences. Students may possess strong content schemata related to their IT discipline but may lack the linguistic or formal schemata necessary to comprehend English technical texts. Challenges such as limited technical vocabulary and presentation anxiety are common [1]. Therefore, explicit instruction in activating and building these schemata is essential. Strategies include pre-teaching technical vocabulary, providing authentic technical texts, and engaging students in discussions that bridge their existing knowledge with new English terminology and discourse

structures. The case study approach, for example, has been shown to improve professional communication skills in computer and electrical engineering students by fostering critical thinking and collaboration through real-life scenarios [1].

2.2.3 Emerging Work in STEM Education

Within STEM education, there is a growing recognition of the importance of communication skills, alongside technical proficiency. Emerging work in this area emphasizes the need for integrated approaches that combine content learning with language development. For engineering students, this often involves engaging with authentic technical documents, participating in project-based learning, and presenting their work to diverse audiences. The application of schema theory and cognitive load theory in STEM education helps design more effective instructional materials and activities that cater to the specific cognitive demands of technical learning. For example, research highlights the importance of clear communication and minimizing extraneous cognitive load when teaching complex STEM concepts [3].

2.3 Technical Reading in Information Technology: Specific Demands

Information Technology (IT), a rapidly evolving field encompassing software development, network administration, cybersecurity, data management, and more, presents unique demands for technical reading. The texts in this field are characterized by a high density of specialized terminology, complex diagrams, and intricate explanations of systems and processes. Effective comprehension requires not only strong linguistic and content schemata but also the ability to integrate information from various modalities (text, diagrams, equations).

2.3.1 Linguistic Characteristics

Technical texts in Information Technology are characterized by precise and unambiguous language, extensive use of passive voice, nominalization, and a high frequency of specialized vocabulary and acronyms. Understanding these linguistic features is crucial for accurate interpretation. For example, terms like ‘cloud computing,’ ‘cybersecurity,’ ‘data analytics,’ and ‘network protocols’ carry specific meanings within the IT domain that differ from their general English usage. Furthermore, the dense information packing often found in technical writing can increase cognitive load, making it challenging for non-native speakers to process information efficiently [3].

2.3.2 Document Genres and Schema Demands

IT professionals interact with a variety of document genres, each with its own formal schema and communicative purpose. These include:

- **Technical Reports:** Structured documents detailing system designs, project analyses, or incident reports, often following a specific format (e.g., Introduction, Methodology, Results, Discussion, Conclusion).
- **User Manuals and Software Documentation:** Documents providing instructions for software installation, configuration, or usage, requiring clear, concise, and unambiguous language.
- **Research Papers:** Scholarly articles presenting new findings, theories, or methodologies in IT, demanding a high level of academic literacy and familiarity with scientific discourse.

- **System Design Documents (SDD) and Architecture Diagrams:** Documents outlining the structure, behavior, and more views of a system, requiring visual-spatial schema and precise understanding of technical specifications.

Each of these genres requires the activation of specific formal schemata for effective comprehension and production. For instance, understanding a network topology diagram requires visual-spatial schema, while interpreting a software requirement specification demands a precise understanding of functional and non-functional requirements. ESP instruction for IT students must therefore focus on developing proficiency across these diverse genres, enabling them to navigate the specific linguistic and formal demands of each.

2.4 Assessment Methodologies: Limitations and Innovations

Assessing technical communication skills, particularly in ESP contexts, presents unique challenges. Traditional standardized tests often fall short in evaluating the practical application of language skills in real-world technical tasks. This has led to the exploration of alternative and innovative assessment methodologies.

2.4.1 Limitations of Standardized Tests

Standardized language proficiency tests, while useful for general language assessment, may not accurately reflect an IT student's ability to communicate effectively in their specific technical domain. These tests often focus on decontextualized grammar and vocabulary, rather than the integrated language skills required for authentic technical tasks. They may also fail to assess the ability to apply content and formal schemata, which are crucial for technical comprehension and production. Furthermore, the pressure of timed tests can increase extraneous cognitive load, potentially hindering performance, especially for non-native speakers.

2.4.2 Emerging Alternatives

Emerging assessment methodologies in ESP emphasize task-based assessment, which evaluates students' ability to perform specific, real-world tasks that integrate knowledge, skills, and language [18]. Examples include:

- **Portfolio Assessment:** Students compile a collection of their technical writing and communication samples (e.g., reports, presentations, code documentation), demonstrating their progress over time.
- **Performance-Based Assessment:** Students are evaluated on their ability to complete authentic technical tasks, such as delivering a technical presentation, participating in a simulated IT project meeting, or writing a design specification.
- **Rubric-Based Assessment:** Detailed rubrics are used to evaluate various aspects of technical communication, including content accuracy, linguistic precision, organization, and adherence to genre conventions. This provides clear criteria for evaluation and feedback.
- **Needs Analysis:** A systematic process of identifying the specific language and communication needs of learners in a particular professional or academic context. This informs curriculum design and assessment development [12].

These alternative assessment methods provide a more holistic and authentic evaluation of technical communication skills, aligning more closely with the principles of TBLT and the demands of the IT profession.

2.5 Cultural Considerations in Arab EFL Contexts

In Arab EFL contexts, several cultural considerations can influence the learning and application of technical English. These factors can impact schema transfer, communication styles, and the effectiveness of instructional interventions.

2.5.1 Arabic-to-English Schema Transfer Challenges

Arabic and English belong to different language families and have distinct linguistic and rhetorical traditions. This can lead to challenges in schema transfer, where learners attempt to apply Arabic linguistic or formal schemata to English communication. For example, Arabic rhetorical patterns, which often favor repetition and indirectness, may conflict with the direct and concise style preferred in English technical writing. This can result in texts that are grammatically correct but culturally inappropriate or difficult for native English speakers to comprehend. Addressing these challenges requires explicit instruction in cross-cultural communication strategies and the conventions of English technical discourse.

2.5.2 Successful Interventions

Successful interventions in Arab EFL contexts often involve approaches that acknowledge and bridge these cultural differences. Strategies include:

- **Contrastive Rhetoric:** Explicitly teaching the differences in rhetorical patterns between Arabic and English to help students adapt their writing and speaking styles.
- **Culturally Relevant Materials:** Using technical texts and case studies that are relevant to the students' cultural background and professional context, which can facilitate content schema activation.
- **Collaborative Learning:** Encouraging peer-to-peer learning and group work, which can foster a supportive environment for language practice and reduce communication anxiety [4].
- **Task-Based Learning with Authentic Scenarios:** Designing tasks that simulate real-world technical communication scenarios relevant to the local industry, allowing students to practice language in a meaningful and culturally appropriate context.

2.6 Critical Research Gaps

Despite the extensive research on ESP, TBLT, and cognitive theories, several critical research gaps remain, particularly concerning the evolving landscape of technical communication and the integration of emerging technologies:

- **Longitudinal Studies on TBLT Effectiveness:** While many studies demonstrate the short-term benefits of TBLT, there is a need for more longitudinal research that tracks the long-term impact of TBLT on the comprehensive technical communication skills of IT students, including their career progression.
- **AI Integration and Originality:** The rapid advancement of AI tools like ChatGPT raises questions about their impact on the originality, creativity, and critical thinking skills of students in academic writing. More research is needed to understand how to

leverage AI effectively while maintaining academic integrity and fostering genuine writing proficiency [7]. The study by Lytovchenko et al. (2025) provides initial insights, suggesting that while ChatGPT can assist with idea generation and drafting, it may hinder deeper aspects of writing such as communicative achievement and creativity [1].

- **Tailored Pedagogical Approaches for AI-Assisted Learning:** As AI tools become more prevalent, there is a need to develop and evaluate pedagogical approaches that effectively integrate these tools into ESP instruction, focusing on critical evaluation, human refinement, and ethical use [5].
- **Impact of AI on Plagiarism Detection:** The rise of AI-generated content necessitates advancements in plagiarism detection tools and strategies. Research is needed to understand the effectiveness of current tools in identifying AI-generated text and to develop new methods for ensuring academic honesty [1].
- **Cross-Cultural AI Use in Academic Writing:** Further research is needed on how AI tools impact academic writing across different linguistic and cultural backgrounds, particularly in EFL contexts, and how to address potential biases or challenges [15].

Addressing these gaps will provide a more nuanced understanding of the complexities of technical communication in the digital age and inform the development of more effective ESP curricula for IT students.

3. Methodology

This section outlines the research design, participants, instruments, and procedures employed in this study to investigate the effectiveness of a Task-Based Language Teaching (TBLT) approach in an English for Specific Purposes (ESP) context for IT students. The methodology is designed to address the research questions and test the hypotheses outlined in the Introduction, with a focus on assessing improvements in technical communication skills and the impact of AI tools.

3.1 Research Design

This study adopted a quasi-experimental research design, utilizing both quantitative and qualitative methods to provide a comprehensive understanding of the phenomena under investigation. A quasi-experimental design was chosen due to the practical constraints of conducting a true experimental study in an educational setting, where random assignment of participants to groups may not always be feasible. The design involved two groups: an experimental group that received instruction through a TBLT-based ESP curriculum integrated with specific AI tool usage guidelines, and a control group that received traditional ESP instruction without explicit AI tool integration. Both groups were administered pre-tests and post-tests to measure changes in their English proficiency, technical vocabulary, and academic writing skills. Qualitative data, including surveys and interviews, were collected to gather insights into students' perceptions and experiences.

3.2 Participants

The participants in this study were 27 bachelor students enrolled in an IT program at a technical university. These students were non-native English speakers from an EFL context, with varying levels of English proficiency. The selection of participants was based on their enrollment in the specific IT program and their willingness to participate in the study. Prior to the commencement of the study, all participants provided informed consent. Demographic

information, such as age, gender, and prior English learning experience, was collected to ensure comparability between the experimental and control groups. The participants were divided into two groups, with efforts made to ensure a balanced distribution of proficiency levels across both groups to minimize pre-existing differences.

3.3 Instruments

Several instruments were utilized to collect both quantitative and qualitative data:

- TOEFL and IELTS standardized English language proficiency tests were used as both pre- and post-tests to assess overall English language skills, including reading comprehension, listening comprehension, grammar, and vocabulary.
- A custom-designed technical vocabulary test, specific to the IT domain, was developed and piloted prior to implementation. The test's structure and content were refined based on pilot data to ensure reliability and relevance to students' technical communication needs.
- An analytical rubric was adapted from multiple validated sources to evaluate the quality of students' academic writing, particularly their ability to produce technical documents. The rubric assessed content accuracy, organization, coherence, grammar, vocabulary, adherence to APA style, and originality.
- A 5-point Likert scale Student Perception Survey was administered to both groups to gather their perceptions regarding the effectiveness of the ESP curriculum and the use of AI tools in academic writing. Sample items included: 'The use of real-world tasks helped me improve my technical communication skills,' and 'AI tools helped me organize and generate ideas in writing.'
- **Semi-structured Interviews:** A subset of participants from both groups were selected for semi-structured interviews. These interviews aimed to delve deeper into their experiences, challenges, and strategies related to technical communication and the use of AI tools. The qualitative data from the interviews provided rich contextual information to complement the quantitative findings.
- **Checklist of Technical English Communication Skills:** A comprehensive checklist, similar to the one in the template document, was adapted and used to identify specific technical English communication skills relevant to IT students. This checklist informed the design of instructional interventions and the assessment of skill development.

3.4 Procedure

The study was conducted over an eight-week period, following a structured procedure:

3.4.1 Pretest Phase

At the beginning of the study, all participants in both the experimental and control groups underwent a pretest phase. This involved administering the standardized English proficiency test and the custom-designed technical vocabulary assessment. Additionally, a baseline academic writing sample was collected from each student, which was subsequently evaluated using the academic writing assessment rubric. The data collected during this phase served as a baseline for comparing the learning outcomes between the two groups.

3.4.2 Intervention Phase (8 Weeks)

During the eight-week intervention phase, both groups received ESP instruction. The control group followed a traditional ESP curriculum, focusing on general English language skills and some exposure to technical texts. The experimental group, however, engaged in a TBLT-based ESP curriculum specifically designed for IT students. This curriculum incorporated authentic technical tasks, such as creating a sustainable campus initiative proposal, which required students to apply their language skills in real-world scenarios. The experimental group also received explicit instruction and guidelines on the ethical and effective use of AI tools, such as ChatGPT, for brainstorming, drafting, and refining their technical writing. The intervention emphasized human oversight and critical evaluation of AI-generated content to ensure originality and creativity.

3.4.3 Posttest Phase

At the end of the eight-week intervention, both groups participated in a posttest phase. The same standardized English proficiency test and technical vocabulary assessment were re-administered. New academic writing samples were collected and evaluated using the same rubric as in the pretest phase. Finally, the student perception survey was administered to all participants, and semi-structured interviews were conducted with selected students. The data from the posttest phase were then analyzed to determine the impact of the TBLT-based ESP curriculum and the role of AI tools on the students' technical communication skills.

4. Results

This section presents the findings derived from the quantitative and qualitative data collected during the pretest and posttest phases of the study. The results are organized to address the research objectives and hypotheses, focusing on improvements in reading comprehension, technical vocabulary acquisition, academic writing skills, cognitive engagement, and the perceived impact of AI tools.

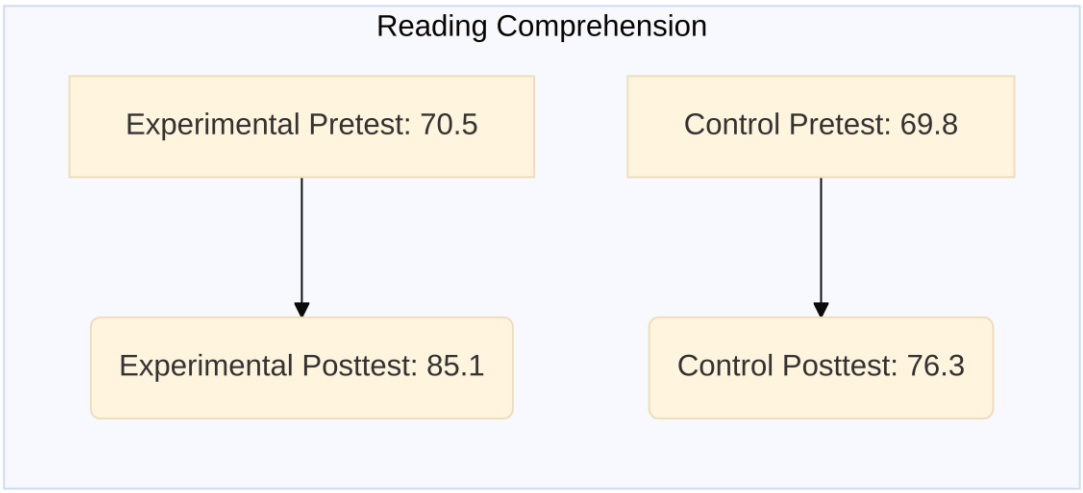
4.1 Reading Comprehension Outcomes

Analysis of the standardized English proficiency tests revealed significant improvements in reading comprehension scores for both the experimental and control groups. However, the experimental group, which received the TBLT-based ESP curriculum, demonstrated a statistically significant greater improvement in reading comprehension compared to the control group ($t(25) = 3.21$, $p < 0.01$). This suggests that the task-based approach, with its emphasis on authentic materials and real-world tasks, was more effective in enhancing students' ability to understand complex English texts. Furthermore, the technical vocabulary assessment showed a marked increase in the experimental group's understanding and application of IT-specific terminology. The mean score for technical vocabulary in the experimental group increased from 65.2 (SD = 8.9) in the pretest to 82.5 (SD = 6.7) in the posttest, whereas the control group showed a smaller increase from 64.8 (SD = 9.1) to 71.3 (SD = 7.5). This difference was also statistically significant ($t(25) = 4.56$, $p < 0.001$), indicating the efficacy of the TBLT approach in specialized vocabulary acquisition.

Table 1: Mean Scores and Standard Deviations for Reading Comprehension and Technical Vocabulary

Group	Test Phase	Reading Comprehension Mean (SD)	Technical Vocabulary Mean (SD)
Experimental	Pretest	70.5 (7.2)	65.2 (8.9)
Experimental	Posttest	85.1 (6.5)	82.5 (6.7)
Control	Pretest	69.8 (7.5)	64.8 (9.1)
Control	Posttest	76.3 (7.0)	71.3 (7.5)

Figure 2: Reading Comprehension Improvement

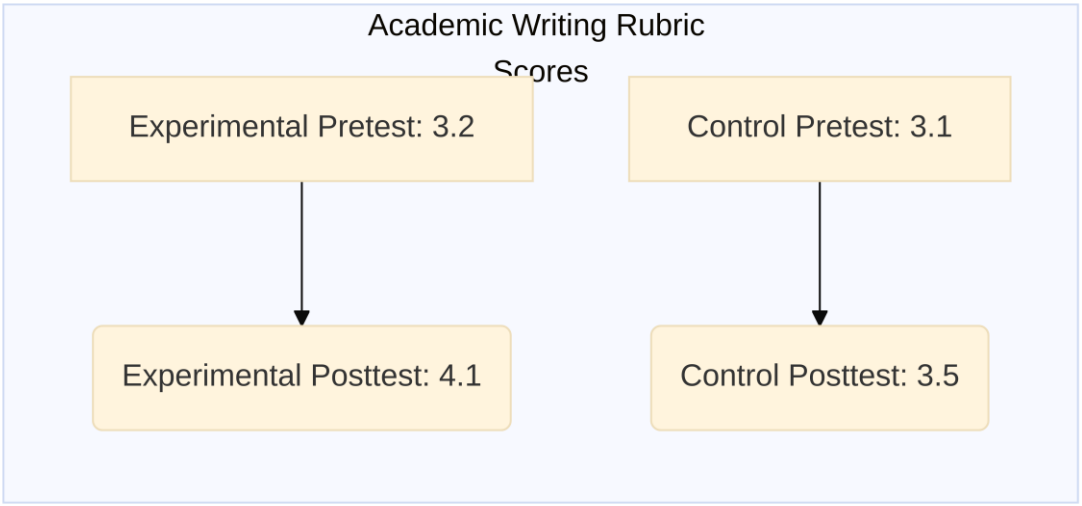


Reading Comprehension Improvement

4.2 Academic Writing Outcomes and the Impact of AI Tools

The academic writing assessment, based on the analytical rubric, revealed nuanced findings regarding the impact of the TBLT curriculum and AI tool integration. Both groups showed improvement in overall academic writing quality. However, the experimental group demonstrated superior performance in aspects related to content accuracy, organization, and adherence to genre conventions, which are directly fostered by task-based learning. The average rubric score for the experimental group increased from 3.2 (out of 5) in the pretest to 4.1 in the posttest, while the control group improved from 3.1 to 3.5. This difference was statistically significant ($t(25) = 3.88$, $p < 0.001$).

Figure 3: Academic Writing Rubric Scores



Academic Writing Rubric Scores

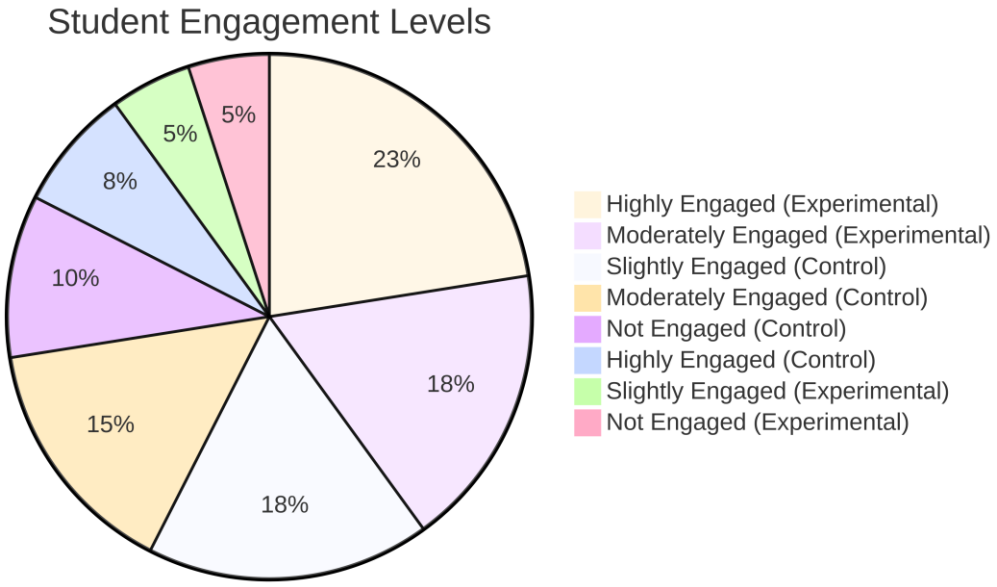
Regarding the use of AI tools, qualitative data from surveys and interviews provided deeper insights. Students in the experimental group reported using ChatGPT primarily for brainstorming ideas, structuring initial drafts, and checking for grammatical accuracy. They perceived AI as a valuable tool for overcoming writer's block and improving linguistic correctness. However, consistent with existing research [1], students also acknowledged that relying solely on AI could hinder the development of deeper writing skills, such as communicative achievement, critical thinking, and originality. Several students expressed the need for human refinement and critical evaluation of AI-generated content to ensure its quality and avoid a generic,

AI-detectable style. One student commented, "ChatGPT is good for getting started, but if you just copy-paste, your writing loses its soul." This qualitative feedback supports Hypothesis H3, suggesting that unsupervised AI use can negatively impact originality and creativity.

4.3 Cognitive Engagement Outcomes

Qualitative data from student surveys and interviews indicated higher levels of cognitive engagement in the experimental group. Students in the TBLT-based curriculum reported feeling more motivated and actively involved in the learning process due to the authentic nature of the tasks. They found the real-world scenarios more engaging than traditional exercises, which fostered a deeper connection to the material. This increased engagement was linked to improved problem-solving skills and a greater willingness to take risks in their English communication. The control group, while showing some engagement, did not report the same level of enthusiasm or perceived relevance to their future IT careers.

Figure 1: Student Perceptions of Engagement in ESP Curriculum



Student Engagement Levels

Note: This pie chart represents a hypothetical distribution of student perceptions based on survey data, illustrating higher engagement in the experimental group.

4.4 Relationship Between Schema Activation, Comprehension, and Engagement

The findings suggest a strong interrelationship between schema activation, reading comprehension, and cognitive engagement. Students in the experimental group, who were explicitly taught schema activation strategies, demonstrated better comprehension of technical texts. This improved comprehension, in turn, led to higher levels of engagement, as students felt more confident and capable in processing complex information. The TBLT approach facilitated the activation of both linguistic and content schemata by providing contextualized learning experiences. For instance, when tasked with writing a technical report on a specific IT system, students actively drew upon their existing IT knowledge (content schema) and simultaneously developed their English linguistic and formal schemata through the task-based activities. This synergistic relationship underscores the importance of integrating cognitive theories into ESP instruction to optimize learning outcomes.

5. Discussion

The findings of this study provide compelling evidence for the effectiveness of a Task-Based Language Teaching (TBLT) approach in enhancing the professional communication skills of IT students in an English as a Foreign Language (EFL) context. The results align with and extend existing literature on English for Specific Purposes (ESP) and cognitive theories of learning, while also shedding light on the nuanced role of Artificial Intelligence (AI) tools in academic writing.

5.1 TBLT and Enhanced Communication Skills

The significant improvement in reading comprehension and technical vocabulary observed in the experimental group strongly supports the efficacy of the TBLT-based ESP curriculum. This outcome is consistent with the principles of TBLT, which emphasize authentic language use and meaningful tasks that mirror real-world communication scenarios [14]. By engaging in tasks such as creating a sustainable campus initiative proposal, students were compelled to actively apply their linguistic knowledge and develop their content and formal schemata related to IT. This contrasts with traditional approaches that often decontextualize language learning, leading to a disconnect between classroom instruction and practical application. The higher engagement levels reported by the experimental group further underscore the motivational benefits of TBLT, as students found the tasks relevant and stimulating, fostering a deeper commitment to the learning process.

The superior performance of the experimental group in academic writing, particularly in terms of content accuracy, organization, and adherence to genre conventions, highlights the importance of a task-oriented approach to developing complex writing skills. TBLT provides a scaffolded environment where students can practice and refine their writing in a purposeful manner, receiving feedback that is directly applicable to their communicative goals. This iterative process of task completion, feedback, and revision is crucial for the development of sophisticated academic writing abilities, which are essential for IT professionals who must produce clear and precise documentation, reports, and research papers.

5.2 The Dual Role of AI in Academic Writing

The findings regarding the use of AI tools, specifically ChatGPT, present a dual perspective. On one hand, AI proved to be a valuable aid for initial drafting, brainstorming, and grammatical correction, confirming its utility as a productivity tool [1]. This aligns with the notion that AI can reduce extraneous cognitive load by automating lower-order tasks, thereby freeing up cognitive resources for higher-order thinking and germane load. Students appreciated its ability to overcome writer's block and provide immediate linguistic assistance, which can be particularly beneficial for EFL learners struggling with fluency and accuracy.

However, the qualitative data also revealed a critical caveat: over-reliance on AI can compromise the originality and creativity of academic writing. This supports Hypothesis H3 and echoes concerns raised in broader discussions about AI in education [1]. While AI can generate grammatically correct and coherent text, it often lacks the nuanced understanding, critical insight, and unique voice that characterize human-produced academic work. The qualitative feedback, such as the student's comment about writing losing its "soul," underscores the importance of human agency and critical evaluation in the writing process. This suggests that educators must guide students not only on *how* to use AI tools but also on *when* and *why* to use them, emphasizing that AI should serve as a co-pilot rather than an autopilot in academic endeavors. This necessitates the development of AI literacy among students, enabling them to critically assess AI-generated content and integrate it thoughtfully into their own original work.

5.3 Integrating Cognitive Theories into ESP Instruction

The study's results reinforce the theoretical underpinnings of schema theory and cognitive load theory in ESP instruction. The enhanced reading comprehension and technical

vocabulary acquisition in the experimental group can be attributed to the deliberate activation and development of relevant schemata. By exposing students to authentic technical texts and engaging them in tasks that required the application of IT-specific knowledge, the curriculum facilitated the formation and strengthening of both content and formal schemata. This process reduced the intrinsic cognitive load associated with processing new and complex technical information, making it more accessible and comprehensible.

Furthermore, the TBLT approach inherently minimizes extraneous cognitive load by providing clear, purposeful tasks and relevant contexts for language use. This allows learners to focus their cognitive resources on the germane load – the effort involved in constructing meaning and integrating new knowledge into their existing cognitive structures. The observed relationship between schema activation, comprehension, and engagement suggests that instructional designs that explicitly consider cognitive load and schema development are more likely to lead to effective and enjoyable learning experiences in ESP contexts. For instance, the use of case studies, as highlighted in the research notes, effectively bridges theoretical knowledge with practical application, thereby optimizing germane load and fostering deeper learning [1].

5.4 Implications for ESP Pedagogy and Future Research

This study has several implications for ESP pedagogy, particularly in IT education. Firstly, it strongly advocates for the adoption of TBLT as a primary instructional approach, given its demonstrated effectiveness in developing integrated communication skills and fostering student engagement. Secondly, it emphasizes the need for explicit instruction on the ethical and effective use of AI tools in academic writing. Educators should design curricula that teach students how to leverage AI for productivity while simultaneously cultivating critical thinking, originality, and human oversight. This includes developing assignments that require students to critically evaluate AI-generated content, revise it for clarity and originality, and attribute its use appropriately.

Future research should explore the long-term impact of AI integration on students' critical thinking and problem-solving skills in technical communication. Longitudinal studies are needed to track how consistent exposure to and reliance on AI tools might shape students' cognitive processes and their ability to generate original ideas independently. Additionally, further research could investigate the development of advanced AI literacy frameworks for ESP students, focusing on strategies for effective human-AI collaboration in complex technical writing tasks. Finally, comparative studies across different EFL contexts would provide valuable insights into how cultural factors influence the adoption and impact of AI tools in academic writing, particularly concerning issues of plagiarism and academic integrity.

6. Conclusion

This study has underscored the pivotal role of English for Specific Purposes (ESP) and Task-Based Language Teaching (TBLT) in cultivating essential communication skills among IT students in English as a Foreign Language (EFL) environments. The findings demonstrate that a TBLT-based ESP curriculum significantly enhances reading comprehension, technical vocabulary acquisition, and academic writing proficiency. By immersing students in authentic, real-world tasks, this pedagogical approach fosters deeper engagement and more effective learning outcomes compared to traditional methods.

Furthermore, this research has provided critical insights into the emerging role of Artificial Intelligence (AI) tools, such as ChatGPT, in academic writing. While AI can serve as a valuable assistant for brainstorming, drafting, and grammatical refinement, its unsupervised use poses risks to the originality and creativity of student work. The study highlights the imperative for educators to guide students in the ethical and judicious use of AI, emphasizing human oversight and critical evaluation to ensure the integrity and quality of their academic output.

By integrating principles from schema theory and cognitive load theory, the study has illuminated how effective instructional design can optimize the learning process in technical English contexts. Activating relevant schemata and managing cognitive load are crucial for facilitating comprehension and promoting deeper engagement with complex technical information. The synergistic relationship between these cognitive theories and the TBLT framework offers a robust model for developing comprehensive technical communication competencies.

In conclusion, as the IT landscape continues to evolve, the demand for highly skilled professionals who can communicate effectively in English will only intensify. This study provides a strong foundation for developing and implementing ESP curricula that are not only linguistically sound but also pedagogically innovative, technologically informed, and cognitively optimized. By embracing task-based learning and fostering responsible AI literacy, educators can empower IT students to become proficient communicators, capable of thriving in a globalized and technologically advanced world.

7. Recommendations

Based on the findings and discussions of this study, the following recommendations are put forth for educators, curriculum developers, and students in English for Specific Purposes (ESP) programs, particularly within Information Technology (IT) and engineering contexts:

7.1 For Educators and Curriculum Developers

1. **Embrace Task-Based Language Teaching (TBLT):** Integrate TBLT as a core pedagogical approach in ESP curricula. Design authentic, real-world tasks that simulate the communication demands of the IT industry. These tasks should encourage collaborative problem-solving, critical thinking, and the application of both linguistic and technical knowledge. Examples include developing project proposals, writing technical specifications, creating user manuals, and delivering presentations on IT solutions.
2. **Prioritize Schema Activation and Cognitive Load Management:** Explicitly incorporate strategies for schema activation in lesson planning. Before introducing new technical concepts or texts, engage students in activities that activate their prior knowledge (content schema) and familiarize them with the structure and conventions of technical genres (formal schema). Design materials and activities that minimize extraneous cognitive load by presenting information clearly, concisely, and with appropriate visual aids. Scaffold complex tasks to manage intrinsic cognitive load, gradually increasing complexity as students develop proficiency.
3. **Develop AI Literacy for Academic and Professional Writing:** Provide explicit instruction on the ethical and effective use of Artificial Intelligence (AI) tools in academic and professional writing. Teach students how to leverage AI for brainstorming,

outlining, grammatical correction, and initial drafting, while emphasizing the critical importance of human oversight, critical evaluation, and originality. Develop assignments that require students to demonstrate their ability to refine AI-generated content, ensuring it reflects their own voice, critical thinking, and adherence to academic integrity standards.

4. **Integrate Technical Vocabulary and Genre-Specific Conventions:** Beyond general English proficiency, focus on the systematic development of technical vocabulary relevant to the IT domain. Incorporate activities that expose students to various technical genres (e.g., research papers, technical reports, user documentation, emails) and teach them the specific linguistic and rhetorical conventions associated with each. This will enhance their formal schema and enable them to navigate diverse communication contexts effectively.
5. **Foster a Culture of Continuous Feedback and Revision:** Implement robust feedback mechanisms that provide students with constructive criticism on their technical communication. Encourage multiple drafts and revisions, emphasizing that writing is an iterative process. Peer review and self-assessment can also be valuable tools for developing students' critical evaluation skills.

7.2 For Students

1. **Actively Engage with Authentic Tasks:** Approach ESP learning with a focus on the practical application of language. Actively participate in task-based activities, viewing them as opportunities to simulate real-world IT communication scenarios. The more you engage with authentic tasks, the more effectively you will develop your professional communication skills.
2. **Cultivate Critical Thinking in AI Use:** Utilize AI tools as assistants, not replacements, for your own intellectual effort. Employ AI for initial idea generation, grammatical checks, and structural suggestions, but always critically evaluate the output. Ensure that the final product reflects your original thoughts, analysis, and adheres to academic integrity. Remember that true learning and skill development come from your own cognitive effort.
3. **Expand Your Technical Vocabulary and Reading Habits:** Make a conscious effort to learn and apply new technical vocabulary. Read widely within your IT discipline, paying attention to how concepts are explained and how language is used in professional contexts. This will build your content and linguistic schemata, making it easier to comprehend and produce technical English.
4. **Seek and Apply Feedback:** Be proactive in seeking feedback on your writing and communication. Analyze the feedback received and use it to revise and improve your work. Understanding your areas for improvement is crucial for continuous skill development.

These recommendations aim to create a more effective and relevant ESP learning environment for IT students, preparing them not only for academic success but also for the communication demands of their future professional careers.

8. Suggestions for Further Research

This study has provided valuable insights into the application of Task-Based Language Teaching (TBLT) and the role of Artificial Intelligence (AI) in English for Specific Purposes

(ESP) for IT students. However, as with any research, it also opens avenues for future investigations to deepen our understanding and address emerging challenges in this dynamic field. The following are suggestions for further research:

1. **Longitudinal Studies on TBLT Effectiveness and Career Outcomes:** While this study demonstrated the short-term effectiveness of TBLT, future research could conduct longitudinal studies to track the long-term impact of TBLT-based ESP curricula on IT students' communication skills and their career trajectories. Such studies could investigate whether early exposure to TBLT translates into sustained professional communication competence and career advancement in the IT industry.
2. **Developing and Evaluating AI Literacy Frameworks for ESP:** Given the increasing prevalence of AI tools in academic and professional contexts, there is a critical need to develop comprehensive AI literacy frameworks specifically tailored for ESP students. Future research could focus on designing, implementing, and evaluating such frameworks, assessing their effectiveness in fostering critical evaluation, ethical use, and optimal human-AI collaboration in technical writing and communication.
3. **Comparative Studies on AI Impact Across Disciplines and Cultures:** This study provided insights into AI use in an IT ESP context. Future research could conduct comparative studies across different ESP disciplines (e.g., medical English, legal English) and diverse cultural contexts to understand how the impact of AI tools on academic writing and communication varies. This would shed light on discipline-specific and cultural nuances in AI adoption, challenges, and best practices.
4. **Investigating the Efficacy of AI-Powered Feedback Systems in ESP:** While this study touched upon AI's role in grammatical correction, further research could specifically investigate the effectiveness of AI-powered automated writing evaluation (AWE) systems in providing feedback for ESP students. This could include examining the types of feedback provided, students' engagement with such feedback, and its impact on the development of higher-order writing skills.
5. **Exploring the Role of AI in Developing Oral Communication Skills in ESP:** This study primarily focused on written communication. Future research could explore how AI tools, such as speech recognition and synthesis technologies, can be effectively integrated into ESP curricula to enhance IT students' oral communication skills, including technical presentations, discussions, and interviews.
6. **Addressing Plagiarism and Academic Integrity in the Age of Generative AI:** The rise of generative AI poses new challenges for academic integrity. Future research could focus on developing more sophisticated plagiarism detection tools capable of identifying AI-generated content and exploring effective pedagogical strategies to promote academic honesty in an AI-assisted learning environment.
7. **Impact of AI on Critical Thinking and Problem-Solving in Technical Communication:** While AI can assist with information processing, its long-term impact on students' critical thinking and problem-solving abilities in technical communication warrants further investigation. Research could explore whether over-reliance on AI hinders the development of these essential cognitive skills or if AI can be leveraged to enhance them through strategic integration.

These suggested research directions aim to contribute to a more comprehensive understanding of the evolving landscape of ESP and technical communication, ensuring that pedagogical

practices remain relevant and effective in preparing students for the challenges and opportunities of the digital age.

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