Metaphorical Competence in Aviation English: Unlocking the Language of Scientific Texts in ESP

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ABSTRACT

This study investigates the role of metaphorical competence in interpreting scientific texts, with a focus on enhancing English for Specific Purposes (ESP) in aeronautics. Metaphorical language is often used in scientific discourse to convey abstract and complex concepts. In Aeronautical English, understanding these metaphors is crucial for learners to comprehend technical terminology and communicate effectively in professional settings. The research methodology evaluates students' ability to decode and use metaphorical expressions in technical aeronautical texts, essential for understanding advanced concepts and ensuring clear communication in the aeronautical engineering industry. Data on metaphorical knowledge was collected through pre- and post-tests, which involved administering various metaphorical exercises to the participants. The intervention focused on the metaphorical language analysis of an aviation text. By equipping learners with the skills to recognize and apply metaphorical language, the study aims to enhance their proficiency in Aviation English. The findings are expected to show improvements in the post-assessment phase, demonstrating how mastering technical metaphorical terminology can significantly boost metaphorical competence, a key skill for mastering English in aeronautical engineering. Ultimately, this study seeks to bridge the gap between abstract language and practical application, contributing to more effective and innovative approaches to teaching ESP in aeronautics.

Keywords: Metaphorical competence, Aviation English, ESP, scientific texts, aeronautical engineering.

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1. INTRODUCTION

Traditionally, metaphors were seen mainly as rhetorical devices used to enhance language or add emphasis (Zhou et al., 2022). However, with the rise of cognitive linguistics as a key framework for second language acquisition (SLA) (Luo, 2021), this view has evolved. Researchers now acknowledge that metaphors are not only integral to communication but also play a vital role in shaping thought, influencing fundamental cognitive processes in ways that go beyond mere embellishment. Thus, in the context of second language acquisition, metaphors are seen as essential tools for improving communicative competence, whether in speech or writing (MacArthur, 2010). They help learners grasp abstract concepts and navigate cultural nuances more effectively (Jamrozik et al., 2016). Cognitive linguistics posits that metaphors are not just learned expressions but foundational to understanding and structuring the world. As a result, metaphors have become an integral component of language curricula in applied linguistics departments (Boers, 2003), particularly in tertiary education. By incorporating metaphor-based strategies into teaching methods, educators can enhance learners' linguistic flexibility, promote deeper cultural understanding, and foster more effective communication in a second language.

Incorporating didactic strategies like the analysis of aeronautical texts rich in metaphorical elements into the curriculum can greatly enhance learners' metaphorical competence, particularly in aviation English (Robisco-Martín & Cuadrado-Esclápez, 2013). Aeronautical language is often saturated with metaphors, like "flight path," "axis," or "grounded," where the figurative meanings extend beyond their literal interpretations. By engaging with such texts, learners gain insight into how metaphors function flexibly within specialized discourse, which in turn improves their overall comprehension (Aniç, 2014). This innovative approach to curriculum design not only strengthens learners' understanding of technical terminology, as seen in phrases like "quantity of bleed air", but also enhances their grasp of metaphorical expressions used in everyday language, like "there is not one silver bullet that is going to improve aircraft efficiency". Ultimately, these strategies help learners develop the cognitive tools needed to navigate both specialized aviation language and broader communication contexts.

This study explores the role of metaphorical competence in second language acquisition within the context of aeronautical discourse. The aim is to determine whether integrating metaphors into aeronautical contexts can enhance metaphorical competence, and by extension, communicative competence. To achieve this, the development of training materials and intervention programmes is crucial for implementing effective didactic strategies in ESP (Gutiérrez-Pérez, 2018). More specifically, these strategies are grounded in the principles of Conceptual Metaphor Theory (Lakoff & Johnson, 1980), which is a key framework in cognitive linguistics. By engaging with complex, field-specific texts, learners can deepen their understanding of how metaphors function across different domains, drawing on perspectives informed by embodied simulations and dynamical systems theory (Gibbs & Cameron, 2008). This approach not only strengthens linguistic proficiency but also intensifies cognitive skills, enabling learners to use metaphors more effectively and navigate both technical and everyday communication in aviation contexts.

Ultimately, metaphors, which are prevalent in aviation discourse, help to simplify complex concepts and facilitate understanding in high-pressure situations. By embedding metaphors as structure-mapping processes (Gentner & Bowdle, 2008) into aeronautical texts, learners can more effectively grasp abstract or technical ideas. This approach allows metaphors to bridge the gap between unfamiliar jargon and intuitive knowledge, making complex aviation terminology more

accessible. Through this mapping of familiar concepts onto unfamiliar ones, learners can better navigate the intricate language of aviation, improving both comprehension and communication skills in real-world scenarios. For example, metaphors like "navigating through turbulence" or "the cockpit as the nerve center" create mental images that make technical procedures more relatable.

2. THEORETICAL BASIS

2.1. ESP

In today's global market, English has become the dominant language of communication, driving the need for English for Specific Purposes (ESP) education (Hyland & Jiang, 2021). ESP focuses on teaching English customized for particular professional fields, like business, aviation, medicine, or technology, equipping learners with the language skills required for their specific careers (Hyland, 2022). As businesses and industries expand globally, professionals must manage cross-cultural communication, understand technical jargon, and engage in international collaborations, making ESP a crucial tool (Kennedy, 2012). Unlike general English courses, ESP focuses on practical language use, addressing industry-specific vocabulary, communication styles, and real-world scenarios (Marcu, 2020). This tailored approach ensures that learners can effectively participate in the global economy, advancing their careers and improving productivity. As the global market continues to evolve, the demand for ESP programmes grows, emphasizing the importance of mastering English in specialized contexts to remain competitive and effective in diverse professional environments (Rose, 2019).

On the other hand, as English is the established lingua franca in aviation (Kim & Elder, 2009; Estival et al., 2016; Ishihara & Prado, 2021), it is essential for projects within the industry to be developed and publicised in English to achieve commercial growth. The global nature of aviation demands seamless communication across diverse cultures and regions, and English serves as the unifying language that ensures clarity and understanding (Moder, 2012). For companies looking to broaden their influence, creating project materials, marketing campaigns, and technical documentation in English maximizes accessibility to international stakeholders, including airlines, regulators, and customers. Furthermore, English proficiency allows enterprises to tap into a wider market, attract global investors, and forge partnerships with international firms (Çoban & Bükeç, 2024). In a competitive industry, effective communication in English not only facilitates operational efficiency but also strengthens brand visibility and credibility on the global stage. Therefore, to drive commercial success and foster worldwide collaboration, aviation-related projects must be conceived, developed, and disseminated in English. Hence, the existence of ESP courses in tertiary education is justified, with an impending need to integrate metaphors into these courses to foster the development of metaphorical competence in the aviation industry.

2.2. Metaphorical Competence

Metaphors are powerful teaching tools in SLA, offering a creative and engaging way to overcome linguistic and cultural gaps (Gibbs, 1996). Teachers can use metaphors to assist students in understanding abstract or complex concepts by relating them to familiar, concrete ideas (Nicolaescu, 2024). Thus, "approaches using metaphor-based teaching strategies often regard metaphors (…) as teaching tools that can be adopted by a teacher" (Niebert et al., 2012: 849). For instance, Huang and Chen (2012) explored mastering English for Specific Treatments (EST), which involves the ability to read English texts with scientific knowledge. They took on the significant challenge of translating metaphorical terms used in medicine into Chinese, enabling Chinese doctors and nurses to understand English manuals and apply treatments effectively.

Moreover, mastering metaphorical competence is crucial for bolstering communicative competence, as metaphors play a fundamental role in how we understand and convey complex ideas (Lakoff & Johnson, 1980). Metaphors shape not only language but also thought, influencing how we conceptualize abstract concepts and make sense of the world. In communication, metaphors help to clarify, enrich, and add depth to what we say, empowering speakers to express nuanced meanings more effectively. For second language learners, being able to recognize, understand, and use metaphors appropriately is essential for full participation in conversations and academic discourse. It allows them to bridge cultural barriers, interpret figurative language, and respond to implicit meanings in a manner that promotes connection and understanding (Littlemore & Low, 2006; Low, 2008).

In this regard, metaphors like "life is a journey" (Lakoff, 2006) or "language is a bridge" can make the process of acquiring a new language more tangible and relatable (Bakker, 2012). By introducing metaphorical expressions, teachers can also augment students' cognitive linguistics, enabling them to think about language in dynamic, non-literal ways (Shao, 2024). What is more, metaphors foster cultural awareness, as they often reflect the values, traditions, and worldviews of different societies (Caballero & Ibarretxe-Antuñano, 2009). In view of this, teachers can incorporate metaphors into lessons through stories, role-plays, or interactive activities, encouraging students to both decode and create metaphors with the help of conceptual fluency (Danesi. 1995) This not only reinforces their vocabulary and comprehension skills but also supports deeper cultural and communicative competence, essential for fluent, context-specific language use.

2.3. Technical Texts

Striving to achieve higher communicative competence in tertiary education includes improving metaphorical competence. Thus, integrating metaphors into the instruction of technical texts across various fields can significantly supplement students' understanding and engagement. Technical subjects, whether in engineering, medicine, business, or the sciences, often involve intricate, theoretical ideas that can be difficult for students to grasp (Ghentulescu, 2016). Metaphors offer a link between the technical and the familiar, making these ideas more accessible. For example, in general engineering, concepts like "flow" in fluid dynamics, which is perfectly suitable with aeronautical engineering, or "circuit" in electronics, can be understood through metaphorical frameworks, by means of comparing fluid flow to water in a river or electrical circuits to motorways with vehicles (Comi et al., 2019). For this reason, by comprising metaphors into technical texts, instructors can assist students in visualizing and better understanding the material (Rosaen & Florio-Ruane, 2008), amplifying their cognitive and problem-solving skills (Mayer, 1993). This approach also aids in language acquisition, especially for non-native speakers, as it encourages both literal and figurative language comprehension (Taylor et al., 2017). Additionally, metaphors highlight the cultural and historical context of technical terms, nurturing deeper interdisciplinary connections and broadening students' perspectives (Sheramalovich (2024). Ultimately, using metaphors in technical instruction not only enriches comprehension but also heightens critical thinking and creativity in applying theoretical knowledge to real-world scenarios.

2.3.1. Aeronautical Texts

The aviation industry's rapid growth is leading to more students enrolling in flight and Air Traffic Control (ATC) training, primarily in English, despite most not being native speakers. Since many non-native speakers lack high proficiency in English, it is necessary to address this issue in the ESP classes at the tertiary level. Besides, since the English language level required by the International Civil Aviation Organization (ICAO) appears to be too advanced for these students, B2 proficiency, according to CEFR for languages, is recommended as a more suitable entry level for training (Emery, 2020). In aeronautical texts, technical metaphors are often employed to simplify complex

notions and make them more accessible to a wider audience. Nevertheless, a theoretical framework for refining the teaching and learning of English in an aeronautical discourse is adamant to integrate cognitive learning strategies (Robisco-Martín & Cuadrado-Esclápez, 2013).

In an illustrative example, terms like "wet feet" and "navigation" serve as metaphors that extend beyond their literal meanings, while concepts like "fuelling" or "landing" help to clarify the abstract processes involved in different phases of flight. On top of that, the idea of "stabilizing" or "adjusting course" is frequently applied in project management or troubleshooting, drawing from the aeronautical concept of steadying an aircraft in flight, empowering individuals from diverse backgrounds to cultivate metaphorical competence.

Ultimately, there is a notable gap in the literature regarding the use of metaphor-based instruction in technical fields, particularly in aeronautical engineering. While metaphor use in general language learning has been well-explored, limited research exists on how metaphorical content in specialized texts, like those in aeronautics, can enhance second language learners' metaphorical competence. Moreover, studies on the practical application of metaphor-based teaching strategies to improve comprehension and production of metaphors in aviation-related communication are scarce. This gap highlights the need for research into how metaphor-rich aeronautical texts can be leveraged to improve learners' understanding and use of metaphors in both academic and professional contexts.

All in all, the goal of this research is to explore and highlight the significance of metaphorical competence in understanding and using scientific texts, specifically in the context of English for Specific Purposes (ESP) within aeronautics. Furthermore, the study aims to investigate the role of metaphors in scientific discourse as it seeks to understand how metaphorical language is used to convey abstract and complex scientific ideas, focusing on its prevalence in aeronautical English.

3. METHODOLOGY

3.1. Goals

This research aims to assist learners in decoding and utilize technical expressions critical for grasping intricate perspectives in aeronautical engineering, thereby improving communication in professional contexts. Similarly, the study examines how learners' existing knowledge and intuitive understanding of language help them to interpret and apply metaphorical expressions, which is essential for better comprehension of topics like aerodynamics, air navigation, and safety protocols.

Thus, by focusing on metaphorical language, the study seeks to enhance learners' proficiency in Aviation English, equipping them with the skills needed to recognize, interpret, and use metaphors effectively. In this vein, the findings are expected to demonstrate how improving metaphorical competence can contribute to more effective teaching methods for ESP, leading to better communication and understanding in aeronautical engineering contexts.

3.2 Research gap

While metaphorical competence has been acknowledged as crucial for second language acquisition and communicative competence, there is a notable lack of empirical research on the integration of metaphor-based instruction within English for Specific Purposes (ESP) courses, particularly in highly specialized and technical fields like aeronautics. Most existing studies focus on metaphor use in general or academic English, with limited attention to how metaphor-rich technical texts in aviation can be effectively used to develop L2 learners' metaphorical and communicative competence. Furthermore, little is known about how such instruction impacts learners' ability to interpret and produce metaphors in real-world, aviation-specific professional communication

settings. This underexplored intersection, between metaphorical competence, technical ESP instruction, and aviation discourse, represents a critical research gap that this study aims to address.

3.3 Research questions

In this context, implementing these metaphors in an intervention programme can help to address the following research questions, which aim to reveal improvements in both linguistic and cognitive skills. The research questions will be investigated through the analysis of pre-test and post-test data, within the framework of an intervention programme aimed at assessing and developing metaphorical competence:

1. How are metaphors embedded in aeronautical English texts, and what cognitive functions do they serve for L2 learners?
2. What is the effect of metaphor-focused instruction on learners' ability to comprehend and use metaphorical language in aviation-specific contexts?
3. How does the development of metaphorical competence enhance students' broader communicative abilities within the scope of ESP for aviation?

By analysing pre- and post- data, this study seeks to evaluate the effectiveness of the intervention programme in enhancing metaphorical competence, particularly in the domain of aviation discourse.

3.4. Group and participants´ selection process

The planned methodology for participant selection involved a purposive sampling approach, specifically targeting third-year students enrolled in Aeronautics studies at the Higher Technical School of Aeronautics (UPM) in Madrid. The approval for the study was granted after obtaining consent from the Director of the Department of Applied Linguistics, allowing the recruitment of participants to proceed. Two groups, experimental and control, each consisting of 27 students, were selected for the study. One group was drawn from the Aviation Management branch (experimental group), while the other came from the Aeronautics Engineering branch (control group), ensuring a diverse but relevant participant base within the aeronautics field.

All participants were third-year students, with an average age of 21. They had limited exposure to English-speaking countries and had predominantly received their English education through English for Specific Purposes (ESP) courses. Their English proficiency ranged from intermediate to advanced levels. The students had already studied aeronautical subjects for two years, providing a foundational understanding of aeronautical concepts. In summary, this approach helped ensure that the study could effectively explore the research questions regarding metaphorical competence in the context of aeronautical discourse.

3.5 Research process

The research aimed to examine how metaphor-based teaching strategies could enhance second language learners' metaphorical competence in aeronautical studies. It followed a structured process involving surveys, pre-assessment, instructional intervention, post-assessment, and data analysis. The intervention programme was administered exclusively to the experimental group and lasted for eight consecutive weeks. It was designed to integrate aeronautical content with metaphor

instruction to help students understand and use metaphorical expressions in technical contexts, thereby improving communication skills in aviation.

Course content included the analysis of scientific aeronautical texts rich in metaphors, supported by multimedia resources, metaphor identification exercises, and interactive, gamified activities. The instructional design was grounded in active learning and task-based language teaching. Tasks included reading comprehension, metaphor recognition, and written production. Progress was tracked through formative and summative assessments, with ongoing feedback and adaptations made to meet students' needs and enhance learning outcomes.

3.6. Procedure

The research procedure follows a structured pre- and post-assessment approach to evaluate the effectiveness of the intervention in improving students' metaphorical competence in aeronautical English. Initially, the pre-test phase is used to assess students' baseline understanding of metaphorical language, focusing on their ability to recognize and interpret metaphors in aeronautical contexts. In the intervention phase, a structured learning program is implemented, where students receive explicit instruction on metaphors in aeronautical discourse. This phase aims to implement their comprehension and use of metaphorical expressions within the technical language of the field. Finally, the post-test phase compares students' performance in the pre- and post-assessments to determine any improvements in their metaphorical competence. Additionally, qualitative data from surveys are collected to identify patterns in learners' experiences, particularly how exposure to metaphorical language and native English may contribute to their understanding of both the language and aeronautical concepts.

3.7. Data Analysis

To address the research questions, specific qualitative and quantitative analysis methods were employed to measure and interpret students' metaphorical competence in the context of aeronautical English.

For the first research question, a content analysis of selected aeronautical texts was conducted. Metaphorical expressions were identified and categorized using a conceptual metaphor framework. Each metaphor was analyzed for its cognitive function, in terms of simplifying abstract concepts, enhancing memory, or aiding technical comprehension. The findings were further interpreted to evaluate how these metaphors may support L2 learners in conceptualizing complex aeronautical processes.

To address the second research question, quantitative data were collected through pre- and post-intervention assessments administered to the experimental group. These assessments focused on metaphor identification, interpretation, and usage within aviation discourse. A paired-sample t-test was conducted to compare learners' scores before and after the eight-week intervention. Descriptive statistics (mean, standard deviation, and range) were also calculated to support the analysis and illustrate performance gains.

For the third research question, students completed written production and comprehension tasks that were evaluated for both metaphor use and overall communicative clarity in aviation-specific contexts. Descriptive statistics were used to track improvement, and histogram charts were created to visually represent score distributions and learning progression. This combined approach allowed

for a comprehensive, data-driven understanding of how metaphorical competence supports broader communication skills in ESP for aviation.

4. RESULTS

The results section presents an analysis of the data gathered from various assessments conducted throughout the study. It highlights key findings from the exercises performed by the undergraduates, focusing on their progress in metaphorical competence. Statistical comparisons between pre- and post-assessments are provided to evaluate the usefulness of the instructional approach. In this sense, diverse forms of evaluation have long been recognized as crucial linguistic tools for gathering comprehensive data from a student corpus. These methods, ranging from reading comprehension to written assessments provide valuable insights into learners' language proficiency, cognitive development, and areas needing improvement. In the case of proving that the pupils improve their metaphorical competence through the discourse analysis of a scientific text, a multifaceted approach to task-completion has been given by embracing varied evaluative techniques that assess both understanding and creative application of metaphors across different contexts.

In view of this, this section will shed light on the repercussions of the results of the varied tests applied to discern statistical differences between the pre- and post-assessments. It will encompass the functional pedagogical implementation of meticulously examining a technical text and metaphorically interpreting its content, highlighting how these strategies contributed to students' improvement in metaphorical competence. By analysing the data, this section aims to provide insights into the impact of these teaching methods on raising students' cognitive and linguistic skills.

4.1. Improvement in Learners' Metaphorical Competence

In response to the first research question, about how metaphors are embedded in aeronautical English texts, and what cognitive functions they serve for L2 learners, a metaphorical competence assessment was administered to investigate how learners identify, interpret, and apply metaphorical expressions. The analysis focused on how metaphorical language facilitates comprehension and supports learners' cognitive processing of complex concepts.

The assessment included tasks adapted from Sambursky (2020), based on *A Good Turn of Phrase* by Milton and Evans (2000), and served as a diagnostic tool to explore learners' developing metaphorical awareness. Key linguistic tasks, metaphor identification, interpretation, and application, were used to evaluate how effectively students could recognize and understand metaphorical structures in context. These tasks specifically targeted metaphors embedded in scientific and technical texts relevant to aviation, offering insight into how such language supports the abstraction and simplification of technical content.

Furthermore, three types of tasks were used: reading comprehension, written comprehension, and written production. The reading comprehension task encouraged students to analyze metaphorical expressions within context, helping them distinguish between literal and figurative language. This process fostered critical thinking and supported learners' ability to interpret metaphor as a tool for conceptualizing abstract aeronautical phenomena. The written comprehension task involved explaining metaphorical meanings in writing, enhancing students' understanding of how metaphors function within technical discourse. Finally, the written production task required students to generate metaphorical language themselves, promoting cognitive flexibility, creativity, and fluency in technical communication.An example of the reading and writing comprehension exercise is

shown below.

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*"What? Another loan? No way, Kim, I've already given you **1) a small fortune!**" Kim shuddered as she knew her father **2) meant business** this time; she could hear it in his voice. "But, Dad… Please! Just until I **3) get the company off the ground**. Once I get some orders I'll be fine… Honest!" She was desperate. Unless her father helped her out, her new clothing company would never get the chance to **4) bear fruit**.*

This type of task reveals how metaphor serves cognitive functions by simplifying complex ideas, making abstract processes more relatable, and enhancing memory retention, key elements in learning technical language. Students were thus not only exposed to metaphorical expressions but were also taught to understand their cognitive roles in meaning-making.

To determine the impact of metaphorical exposure, pre- and post-intervention scores were compared. A paired-sample t-test was used to assess whether significant differences existed in metaphorical competence before and after reading metaphor-rich texts (Table 1). Results demonstrated a statistically significant improvement in learners' written comprehension of metaphors. Specifically, the mean score before the intervention was M = 9.19 (SD = 2.466), while the post-intervention mean increased to M = 11.85 (SD = 2.161), indicating an improvement in students' ability to interpret metaphors embedded in specific contexts.

Table 1. Descriptive statistics for metaphorical competence in written comprehension
(pre- and post-intervention)

	Mean Deviation	N	Standard Deviation	Range
Metaphorical Competence (MC)_Written Comprehension (over 15)_Pre-	9,19	27	2,466	0,475
Metaphorical Competence (MC)_Written Comprehension (over 15)_Post-	11,85	27	2,161	0,416

These results support the conclusion that metaphors embedded in aeronautical texts play a vital cognitive role for L2 learners. By linking unfamiliar technical content to familiar conceptual domains, metaphors serve as cognitive scaffolds, aiding comprehension, supporting memory, and enhancing communicative competence in ESP contexts. These findings support the inclusion of metaphor-focused strategies in ESP teaching to make complex content more accessible and improve learners' overall communicative ability.

4.2. Impact on Comprehension and Communication Skills

Secondly, addressing the second research question, which explores the effect of metaphor-focused instruction on learners' ability to comprehend and use metaphorical language in aviation-specific contexts, the study employed a scientific text centered on a three-page aeronautical article titled *How the Future of Electric Aircraft Lies Beyond the Engine*. This text, rich in technical vocabulary

specific to aeronautical engineering, was deliberately chosen for its abundant use of metaphorical expressions, providing an ideal context for applying metaphor-based teaching strategies aimed at enhancing students' comprehension and practical use of specialized aeronautical language.

The analysis focused on helping students to recognize and interpret these metaphors within the technical context using gamification. One such method involves an interactive fill-in-the-gap exercise, where students work in teams or individually to complete a scientific aviation text split into nine sections. Each section contains an average of seven gaps, and students must select the correct metaphorical expressions from a provided box to fit into the gaps. The exercise is time-limited, adding an element of urgency, and students have multiple attempts to get the answers right, reinforcing learning through repetition and competition. This gamified approach fosters collaboration, critical thinking, and a deeper understanding of aviation terminology in an enjoyable and dynamic environment.

 All things considered, by engaging with this content interactively, learners discovered how enjoyable didactic strategies focused on metaphorical language can boost the understanding of complex aeronautical concepts.Access to the interactive game is available through a web link or QR code:

https://h5p.org/node/1525992

Regarding the statistical analysis, by the time the post-assessment was conducted, the scientific text-oriented exercise had been completed, and the results for the written production variable clearly revealed significant differences. Table 2 below indicates that significant statistical differences were found between the pre- and post-measurements results in this variable. The reading is as follows: metaphorical competence in written production was significantly higher in the post-test assessment (M = 4.52, SD = 2.532) than in the pre-test measurement (M = 7.52, SD = 2.455, P <.005).

Table 2. Descriptive statistics in metaphorical competence – Written Production

	N	Mean Deviation	Standard Deviation	Mínimum	Maximum
Metaphorical Competence (MC)_Written Production (out of 10)_Pre-	27	4,52	2,532	0	9
Metaphorical Competence (MC)_Written Production (out of 10)_Post-	27	7,52	2,455	2	10

Additionally, the results showed that there truly were significant differences between the total metaphorical competence before and after exposure to the scientific text. The metaphorical competence variable score (Table 3) before the intervention had lower values (M= 13.70, SD = 4.445) than the variable score after the intervention (M = 19.37, SD = 3.681).

Table 3. Descriptive statistics in total metaphorical competence

	Mean Deviation	N	Standard Devaition	Range
Metaphorical Competence (MC)_TOTAL (out of 25)_Pre-	13,70	27	4,445	0,855
Metaphorical Competence (MC)_TOTAL (out of 25)_Post-	19,37	27	3,681	0,708

Lastly, a t-test (table 4) for dependent samples showed that this difference was statistically significant, $t(26) = -6.267$, $p = .000$, 95% confidence interval (-7.525, -3.808). In summary, the scores in total metaphorical competence increased after the intervention, so the intervention was effective.

Table 4. Paired samples t-test for total metaphorical competence

| | Paired Differences | | | | | | | |
| | | | | 95% confidence interval of the difference | | | | |
	Media	Desv. Deviation	Desv. Error average	Inferior	Superior	t	Paire	Sig. (bilateral)
Metaphorical Competence (MC)_TOTAL (out of 25)_Pre- Metaphorical Competence (MC)_TOTAL (out of 25)_Post-	-5,667	4,699	0,904	-7,525	-3,808	-6,267	26	0,000

These findings strongly support the effectiveness of metaphor-focused instructional strategies in enhancing learners' understanding and use of specialized language in aeronautical communication. The significant improvement in written production and total metaphorical competence suggests that teaching strategies anchored in metaphor identification and application help students better internalize and employ technical vocabulary.

Gamified exercises, in particular, proved to be an effective pedagogical tool, reinforcing theoretical knowledge through active engagement and peer collaboration. These results align with cognitive linguistic theories, which posit that metaphors are central to conceptual understanding and language development, especially in abstract or technical fields like aviation. In practical terms, these findings underscore the importance of integrating metaphorical content into language instruction for specialized domains. When learners are given tools to decode metaphorical language in context and practice its use through interactive methods, they are more likely to develop the ability to communicate effectively and confidently in domain-specific settings.

4.3. Comprehensive Assessment of Intervention's Effectiveness

The third research question investigates how the development of metaphorical competence enhance students' broader communicative abilities within the scope of ESP for aviation. To address this, a pre- and post-intervention design was employed. By comparing the results before and after the intervention, the study aimed to evaluate how exposure to metaphor-rich aeronautical texts influenced learners' skills in both understanding and producing metaphorical expressions within the context of aviation communication.

The following diagrams play a crucial role in providing visual cues for clarity. Charts 1 and 2 below compares the same variable before and after the intervention programme. Prior to the intervention, the average metaphorical competence in written comprehension (see table 1 above) was 9.19 out of 15, with a standard deviation of 2.47; the minimum score was 4, and the maximum was 14 out of 15. After the intervention, the average score rose to 11.85, with the minimum score being 7 and the maximum score 15 out of 15. This indicates an increase of approximately 3 points in written comprehension. As shown in charts 1 and 2, the written comprehension variable tends to increase after the intervention, with a slight negative skew in the post-test results. A negative skew indicates that most of the data points are clustered towards the higher end of the scale, with a few lower values pulling the average down. Regardless, the second graph presents the scores shifted to the far right, which means an improvement in the post-test.
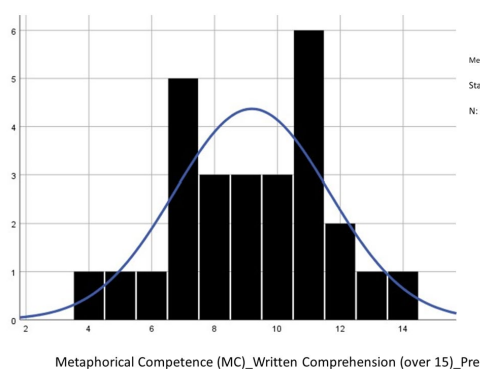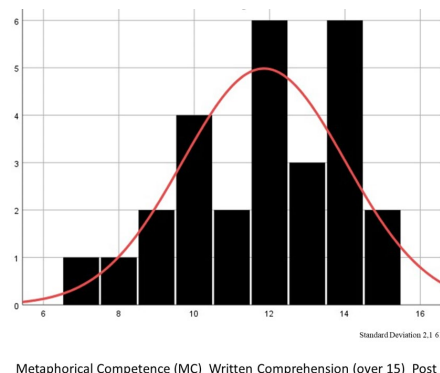

Chart 1. Written comprehension variable pre-

Chart 2. Written comprehension variable post-

Moreover, charts 3 and 4 present the pre- and post-test results for the written production variable within the metaphorical competence test. This variable appears less homogeneous than the other previously assessed, likely due to a negative skew observed when comparing the pre-test and post-test results. Despite this, it is evident that the highest peak in the second graph shifts toward the right end, in contrast to other graph, where the highest peaks remain centred. This indicates that the post-assessment in chart 4 reflects an improvement in metaphorical competence.
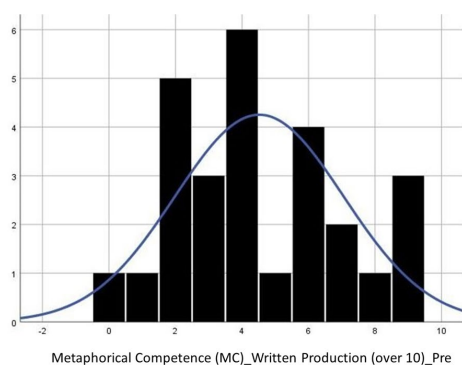
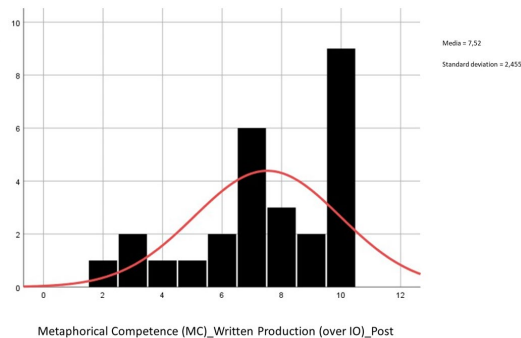Chart 3. Written production variable pre-   Chart 4. Written production variable post-

The visual data confirms a clear trend: learners' metaphorical competence improved after being exposed to metaphor-rich aeronautical texts. The improvement in both written comprehension and written production illustrates the dual benefit of metaphor instruction—not only does it support passive understanding of metaphors in specialized contexts, but it also promotes active metaphor use, a key feature of professional communication in fields like aviation.

These findings align with cognitive linguistic theories that emphasize the conceptual basis of metaphor and its role in learning domain-specific language. By engaging with authentic, metaphor-rich texts, students had the opportunity to observe and internalize how metaphors function within aeronautical discourse. This experiential exposure appears to have deepened their interpretive abilities and inspired more confident, context-appropriate metaphor production.

Moreover, the results reinforce the pedagogical value of including metaphor instruction in technical language education. When learners are provided with the tools and practice to both analyze and create metaphors, they not only enhance their linguistic competence but also their conceptual understanding of technical content. This combination is particularly valuable in fields where metaphor is often used to simplify or conceptualize complex, abstract ideas, as is frequently the case in aeronautical engineering and communication. Finally, the observed post-test improvements underscore the positive effect of metaphorical exposure on learners' communicative performance in aviation contexts, supporting the inclusion of metaphor-based materials and assessments in LSP (Language for Specific Purposes) instruction.

5. CONCLUSION

In conclusion, the data analysis confirms that the integration of metaphorical elements in aeronautical texts has a profound impact on the development of metaphorical competence in second language learners at the tertiary level. The combination of reading comprehension, written comprehension, and written production tasks, along with innovative teaching strategies like gamification, proved to be highly effective in enhancing students' cognitive and linguistic abilities. The significant statistical improvements observed in pre- and post-assessments provide strong evidence for the pedagogical value of metaphor-based instruction in specialized language learning contexts, particularly in fields like aeronautical engineering. The findings of this study not only contribute to our understanding of metaphorical competence but also offer valuable insights into

how metaphor-based learning can support the acquisition of complex, technical language in a second language.

Building on the study's findings, it is clear that metaphor-focused instruction plays a vital role in improving learners' ability to comprehend and use metaphorical language within aviation-specific contexts. Consequently, incorporating metaphor-based strategies into English for Specific Purposes (ESP) curricula is crucial for developing students' metaphorical competence and strengthening their overall communicative skills in technical fields. Furthermore, the use of ongoing feedback, formative assessment, and opportunities for reflective learning supports sustained progress, while dedicated teacher training in metaphor pedagogy ensures these strategies are applied effectively. Collectively, these measures contribute to a more holistic, practical, and learner-centered approach to language instruction tailored to the needs of aviation education.

6. STATEMENTS

6. 1. Conflict of Interest

There is no conflict of interest in this study.

6. 2. Contributions

There is only one author who contributed all the study.

6. 3. Ethical Considerations

Informed consent was obtained from all participants who agreed to take part in the study.

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