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Beyond Routine Phraseology: Developing an Instructional Content Framework for Emergency Aviation English*

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ABSTRACT

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Despite the centrality of English to aviation safety, current Aviation English instruction remains largely confined to routine radiotelephony and standardized phraseology, leaving the distinct communicative demands of emergency situations inadequately addressed. This study develops a structured instructional content framework for emergency Aviation English grounded in a systematic communicative classification of emergency situations. Using a developmental research design, the study analyzes ICAO and FAA regulatory documents, Aviation English literature, and authentic pilot-controller communication data, classifying emergency situations into seven categories according to the communicative functions, linguistic resources, and interactional strategies they require. Building on this communicative analysis, the study develops a four-stage instructional framework comprising Vocabulary and Pronunciation, Communication Protocol, Practice Activities, and Scenario-Based Simulation, designed for implementation across diverse technology-mediated learning environments. As a design and development study, the framework establishes a communicatively grounded instructional foundation for future implementation and empirical evaluation.

KEYWORDS

Aviation English, emergency communication, pilot-controller interaction, technology-mediated learning, instructional content framework

1. Introduction

Aviation is widely recognized as one of the safest modes of transportation. However, when accidents occur, their consequences are often catastrophic. According to the International Civil Aviation Organization (ICAO), approximately 70-80% of aviation accidents are attributed to human factors, with communication breakdowns constituting a substantial proportion of these incidents (Helmreich and Merritt 2017, ICAO 2010). In response to such risks, ICAO introduced the Language Proficiency Requirements (LPRs) in 2008, mandating a minimum English proficiency level for all pilots and air traffic controllers engaged in international operations (ICAO 2010).

Despite these regulatory efforts, considerable concern remains regarding the adequacy of current Aviation English education for handling emergency and non-routine situations. The LPRs have been criticized for their predominant focus on routine radiotelephony, offering limited support for the linguistically demanding, time-pressured interactions that characterize emergency communication (Estival et al. 2016, Kim and Elder 2009). Empirical evidence further suggests a persistent misalignment between assessment-driven training and operational needs. For example, Lee (2014) reports that 93% of Korean pilots perceived the English Proficiency Test for Aviation (EPTA) as ineffective in improving real-world communicative performance, while many identified recurrent re-evaluation stress as a potential threat to flight safety. Similarly, Kim (2023) found that among Korean pilots and controllers who had achieved Level 4 or above on the EPTA, more than 70% self-reported their English proficiency as intermediate or below, indicating that formal certification does not reliably translate into communicative confidence in operational contexts. This gap reflects a mismatch between what LPR-based testing measures and what emergency communication actually demands: Level 4 ratings are largely based on standardized, predictable radiotelephony exchanges (Estival et al. 2016, Kim and Elder 2009), whereas emergency situations require pilots and controllers to adapt their language dynamically, negotiate meaning, manage rapidly evolving situations, and communicate effectively under considerable cognitive pressure. As a result, assessment success does not necessarily indicate preparedness for the interactional demands of non-routine operations. These assessment practices are reflected in current Aviation English instruction, which continues to emphasize routine communication scenarios, standardized phraseology, and predictable interactional patterns (Estival et al. 2016, ICAO 2010, Kim and Elder 2009). While such instruction provides an essential operational foundation, it offers limited preparation for the communicative demands of emergency situations.

To overcome these instructional limitations, alternative training approaches such as high-fidelity simulators, computer-based training (CBT), and more recently immersive technologies have increasingly been adopted. These approaches have expanded opportunities for practice and offer considerable potential for emergency communication training. However, the educational value of such technologies depends on the pedagogical design of their instructional content rather than on technological sophistication alone, underscoring the need for a systematically designed instructional content framework grounded in authentic operational communication.

The present study constitutes the first phase of an ongoing research program aimed at developing a platform independent instructional content framework for emergency Aviation English. The objective is to establish a transferable pedagogical framework that can be implemented across different technology-mediated learning environments. Rather than developing or evaluating a specific technology, this phase focuses on identifying and systematically organizing the communicative content required for effective emergency communication. Because emergency communication requires learners to integrate multiple communicative competencies, including technical vocabulary, communication protocols, procedural communication, and scenario-based interaction, the instructional content needs to support both the progressive development of individual competencies and their subsequent integration during authentic communication. Accordingly, the proposed framework is designed to support their systematic and progressive development. Rather than prescribing a specific technological implementation, the framework establishes a transferable pedagogical foundation that can be adapted to a range of technology-mediated learning environments.

Specifically, the research addresses the following questions:

1. How can emergency situations in flight operations be systematically classified according to their communicative demands in pilot-controller interaction?
2. What linguistic and interactional communication components are required to support effective communication across the identified emergency categories?
3. How can these components be systematically organized into a structured instructional content framework for emergency Aviation English?

Together, these research questions guide the analytical and design-oriented processes of the study, linking the classification of emergency situations to the systematic development of instructional content framework for emergency Aviation English.

2. Literature Review

2.1 Aviation English as Operational Register and Emergency Communication

Aviation English has been conceptualized as a highly specialized operational register whose primary function is to support safety-critical coordination between aviation professionals. Unlike general-purpose English, Aviation English is institutionally regulated, procedurally constrained, and embedded within highly structured interactional contexts. Standard radiotelephony phraseology, as prescribed by ICAO, is designed to minimize ambiguity and ensure predictability in routine operations by limiting lexical choice and syntactic variation (ICAO 2010). Within this framework, language functions as a safety-critical tool that enables coordination, control, and shared situational awareness.

However, research has consistently shown that real-world pilot-controller communication cannot be fully accounted for by standardized phraseology alone. Discourse-analytic studies demonstrate that operational talk frequently departs from prescribed phraseology, particularly in non-routine situations (Morrow et al. 1994, Nevile 2004). These studies show that effective communication depends not only on linguistic accuracy but also on interactional competence, including turn-taking, clarification, information sequencing, and the management of urgency. From this perspective, Aviation English is better understood as an interactional practice embedded in operational decision-making rather than as holding knowledge of fixed expressions alone.

Corpus-based and register-analytic research has provided empirical grounding for the distinction between routine and non-routine aviation communication. Borowska (2017) characterizes standard phraseology as a precisely coded communicative mode and plain language as a more flexible, spontaneously constructed form of expression. In her view, effective emergency communication depends on the strategic combination of both modes under operational pressure. Building on this framework, Zhao (2024) demonstrates through multi-dimensional register analysis that non-routine Aviation English is informationally denser, more viewpoint-oriented, and characterized by higher integrative information flow than its routine counterpart. At the level of interactional structure, Zhao (2023) draws on systemic functional linguistics to show that ATC exchanges differ fundamentally from conversational English in their functional-semantic organization, with a significantly higher proportion of initiating moves and a corresponding reduction in sustaining moves. This pattern reflects the institutionally prescribed, role-asymmetric nature of pilot-controller interaction. Ishihara and Prado (2021) further show that meaning in pilot-controller communication is co-constructed through joint interactional negotiation rather than transmitted unilaterally, and that effective non-routine communication demands what they term “super-explicitness” (p. 650), a heightened degree of redundancy and pragmatic repair that exceeds the norms of other professional ELF contexts. Collectively, these studies establish that aviation communication competence extends well beyond phraseological knowledge to encompass pragmatic and interactional dimensions that current training frameworks largely overlook (Bieswanger 2013, Kim and Elder 2009). For the present study, this body of evidence underscores the need for a dedicated content framework that systematically addresses the distinct linguistic demands of emergency situations.

Emergency and non-routine situations constitute communicative environments that differ qualitatively from routine flight operations, characterized by heightened time pressure, cognitive workload, uncertainty, and potentially catastrophic consequences (Nevile 2004, Orasanu 2017). Under these conditions, pilots and controllers must coordinate action through talk while simultaneously managing rapidly evolving operational demands. Accident and incident analyses consistently show that communication failures in emergencies are rarely attributable to linguistic errors alone. Rather, they frequently involve delayed escalation, incomplete or poorly sequenced information, and ambiguous expressions of urgency. The 1977 Tenerife airport disaster illustrates how pragmatic misinterpretation under time pressure can have fatal consequences (Cushing 1994), and analyses of the Avianca Flight 052 accident similarly reveal that the crew’s failure to use explicit emergency declarations, in favor of ambiguous plain language, contributed directly to the controller’s misreading of the situation (Estival et al. 2016, NTSB 1991). These cases point to a central paradox: while standardized phraseology supports clarity in predictable contexts, it is often insufficient for novel or rapidly evolving situations, compelling speakers to transition to plain English at precisely the moment when linguistic variability poses the greatest risk of misunderstanding (Estival et al. 2016, Kim and Elder 2009, Morrow et al. 1994). Despite broad recognition of these challenges, much of the existing literature has continued to treat emergency communication as an extension of routine radiotelephony rather than as a set of distinct communicative practices warranting differentiated instructional treatment.

2.2 Instructional and Technological Approaches to Aviation English Training

Research examining Aviation English pedagogy has repeatedly pointed to a mismatch between instructional practices and operational communication demands. Traditional classroom-based training and textbook-driven materials tend to emphasize memorization of standard phraseology and predictable interactional patterns (Estival et al. 2016, Kim and Elder 2009). While such approaches establish a functional baseline for routine communication, they are structurally ill-suited to developing the adaptive competences that non-routine and emergency situations demand. Critically, they do not provide learners with opportunities to practice the co-construction of meaning under uncertainty, the management of communicative breakdown, or the strategic deployment of explicitness strategies that emergency interactions require (Ishihara and Prado 2021, Nevile 2004). The result is a persistent instructional gap whereby pilots and controllers may demonstrate adequate proficiency under test conditions while remaining underprepared for the communicative pressures of real emergencies.

CBT systems and early digital learning platforms have expanded access to Aviation English instruction, yet many implementations have focused primarily on vocabulary acquisition and grammatical accuracy (Chapelle 2001). While these systems offer advantages in terms of accessibility and self-paced learning, they frequently lack mechanisms for sustained, interactionally rich communication practice that reflects the reciprocal nature of pilot-controller exchanges in emergency contexts. The limitations of early CBT approaches underscore the need for more sophisticated instructional solutions capable of supporting dynamic, context-sensitive language use.

Recent scholarship advocates a shift toward content-driven and data-informed instructional approaches. Content-Based Instruction has been proposed as a means of integrating language learning with professional knowledge, allowing learners to acquire linguistic resources through engagement with operational subject matter, an approach explicitly endorsed by ICAO's own training guidance (ICAO 2010). This approach recognizes that Aviation English competence develops most effectively when language instruction is embedded within authentic operational contexts rather than taught as an isolated skill set.

Empirical evidence for simulation-based approaches has begun to emerge in the recent literature. Demirdöken and Atay (2024) reported significant gains in both Aviation English vocabulary knowledge and readback performance among ab initio pilots following a semester-long simulation-based course. Qualitative findings further indicated reduced English-speaking anxiety and stronger perceived relevance to occupational needs. As the first documented simulation-based intervention specifically targeting Aviation English proficiency, their study demonstrates the considerable potential of simulation-based instruction. However, the intervention focused primarily on vocabulary development and readback accuracy, leaving the interactional and adaptive communicative demands of emergency situations largely unexplored. These findings suggest that simulation-based instruction is effective for developing foundational Aviation English skills while also highlighting the need for instructional content specifically designed to address the communicative complexity of emergency operations.

This need is further supported by studies emphasizing the value of authentic operational language resources for instructional design. Drayton and Coxhead (2023) demonstrated the value of empirically grounded, corpus-derived lexical resources through the development of the Tower Aviation Radiotelephony Technical Vocabulary List. Similarly, Kim (2023) showed that targeted exposure to authentic radio transmissions can mitigate communicative difficulties associated with rapid speech, accent variation, and transitions to plain English. Taken together, these studies suggest that authentic operational communication constitutes an essential foundation for Aviation English instruction. Rather than relying on generalized language teaching, instructional content should be systematically derived from authentic operational language and communication practices.

To overcome these instructional limitations, recent research has increasingly explored technology enhanced learning as a means of supporting more authentic and contextually situated Aviation English instruction. Studies have shown that immersive learning environments can support situated learning by enabling learners to engage in contextually meaningful tasks and role based interaction (Mystakidis 2022, Peterson 2016). Their affordances, including spatial presence, embodied interaction, and real time feedback, align well with the communicative and operational demands of Aviation English. In aviation related domains, virtual reality and simulation technologies have been applied primarily to procedural training, including flight operations, maintenance, and safety drills (Chittaro and Buttussi 2015). While these applications demonstrate the educational potential of technology enhanced environments, relatively few studies have examined their effectiveness for developing Aviation English communication competence, particularly in emergency situations.

Importantly, previous research has consistently emphasized that the effectiveness of technology enhanced language learning depends less on technological sophistication than on the pedagogical design of instructional tasks and content (Chapelle 2001, Peterson 2016). Without instructional content systematically derived from authentic operational communication, even highly sophisticated learning environments risk reproducing the limitations of conventional training approaches. This observation reinforces the need for a structured instructional content framework grounded in authentic operational communication and designed for implementation across a range of technology-mediated learning environments. This pedagogical principle provides the theoretical foundation for the framework developed in the present study.

3. Methodology

3.1 Research Design

This study adopts a developmental research design to construct a structured instructional content framework for Aviation English communication training targeting pilot-controller communication in emergency situations. In line with developmental research principles, the focus is placed on the systematic design and documentation of instructional content grounded in operational needs and established sources, rather than on experimental evaluation of learning outcomes (Richey and Klein 2014). The instructional problem addressed concerns the limited availability of scenario-specific Aviation English materials that adequately reflect the linguistic and interactional demands of non-routine and emergency flight operations. While existing resources predominantly emphasize routine radiotelephony, emergency communication requires flexible integration of standardized phraseology and plain English.

Accordingly, the study focuses on the systematic organization of instructional content for emergency Aviation English. The framework was developed through analysis of regulatory standards, authentic pilot-controller communication data, and relevant pedagogical literature, with the aim of identifying the core communicative components and sequencing principles required for effective emergency communication training. The resulting framework is intended to provide a foundational basis for future implementation in immersive training environments.

3.2 Data Sources and Collection

To ensure authenticity, validity, and instructional relevance, data were collected from three categories of established and publicly available sources. The first category comprised international aviation standards and regulatory documents published by ICAO and Federal Aviation Administration (FAA), which were examined to establish an authoritative basis for emergency classification and baseline communication requirements. The reviewed materials included relevant Annexes to the Convention on ICAO, namely Annex 1 (Personnel Licensing; ICAO 2020), Annex 6 (Operation of Aircraft; ICAO 2018a), Annex 10 (Aeronautical Telecommunications; ICAO 2018b), and Annex 17 (Security; ICAO 2017), as well as key operational manuals including Doc 4444 (Procedures for Air Navigation Services - Air Traffic Management; ICAO 2016), Doc 9432 (Manual of Radiotelephony; ICAO 2007), Doc 9835 (Manual on the Implementation of ICAO Language Proficiency Requirements; ICAO 2010), the ICAO Accident/Incident Data Reporting (ADREP) Taxonomy (ICAO n.d.), and the FAA Aeronautical Information Manual (AIM; FAA 2025). These documents were systematically reviewed to identify regulatory definitions of emergency situations, prescribed communication procedures, and guidelines governing the use of standardized phraseology and plain English.

The second category comprised Aviation English educational resources and peer-reviewed scholarly literature, reviewed to inform the pedagogical organization and content structure of instructional content framework. This included textbooks aligned with ICAO standards (e.g., Estival et al. 2016), as well as empirical and theoretical studies addressing key domains such as pilot-controller communication, non-routine operational discourse, simulation-based training, and communication breakdowns in aviation contexts. These sources were used to triangulate and refine the communicative components identified from the primary data, ensuring alignment with established research in Aviation English and applied linguistics.

The third category consisted of authentic pilot-controller communication data collected from publicly available and officially released sources, including accident and incident investigation reports and government-published aviation safety resources containing communication transcripts or documented analyses of emergency interactions. In addition, publicly accessible emergency communication materials released by the Ministry of Land, Infrastructure and Transport of the Republic of Korea were incorporated, providing case-based safety resources that combine contextual explanations of aviation incidents with recorded or reconstructed pilot-controller communications. All data sources were publicly available, officially archived, and explicitly intended for safety or training purposes, ensuring both ethical transparency and traceability.

3.3 Development Procedures

The development of the instructional content framework proceeded through three sequential phases, each addressing a distinct stage of the framework development process: (1) classification of emergency situations according to their communicative demands, (2) identification of the linguistic and interactional components required for effective emergency communication, and (3) systematic organization of these components into a structured instructional content framework.

In the first phase, emergency situations relevant to pilot-controller communication were classified according to their communicative demands. Although the data sources included a broad range of international aviation documents, the classification process was guided primarily by the ICAO ADREP Taxonomy, ICAO Doc 4444, and the FAA AIM, which describe emergency occurrences and operational communication procedures from complementary perspectives. Because these documents were developed primarily for operational guidance or occurrence reporting rather than instructional purposes, no single existing taxonomy was adopted directly. Instead, the documented emergency situations were systematically compared with respect to the communicative demands they imposed on pilot-controller interaction. Situations that required similar patterns of information exchange, linguistic resources, and interactional management were grouped into common instructional categories, whereas those requiring substantially different communicative strategies were retained as separate categories. For example, the ICAO ADREP Taxonomy distinguishes engine failures, hydraulic failures, electrical failures, and landing gear malfunctions as separate occurrence categories, while the FAA AIM presents corresponding operational procedures individually. Despite these technical distinctions, these events require many of the same communicative functions, including declaring an emergency, reporting aircraft status, describing operational limitations, requesting priority handling, and coordinating approach and landing procedures. Accordingly, these technically distinct events were consolidated into the broader category of mechanical malfunctions. The same analytical principle was applied across all emergency situations to establish the final classification used in this study, resulting in seven emergency categories for instructional purposes: medical emergencies, fuel emergencies, mechanical malfunctions, weather deterioration, bird strikes, unruly passengers, and security threats.

In the second phase, each emergency category was analyzed to identify the linguistic and interactional components required for effective emergency communication. The analysis was conducted through iterative comparison across the collected data sources using a common analytical framework. For each emergency category, the data were examined from four analytical dimensions: (a) the operational context of the emergency (e.g., mechanical malfunction, medical emergency), (b) the communicative functions required during pilot-controller interaction, such as declaring an emergency, requesting priority handling, and exchanging operationally necessary information, (c) the linguistic resources employed, including standardized radiotelephony phraseology, technical vocabulary, and plain language, and (d) the interactional strategies used to manage the flow of communication, such as acknowledging receipt of a message, readback, and clarification requests, rather than the exchange of new operational information addressed under (b). The findings derived from these four analytical dimensions were subsequently synthesized into communicative components for each emergency category. Table 1 illustrates this analytical process using an authentic pilot-controller communication excerpt categorized as a mechanical malfunction and adapted from ICAO Doc 9835 (ICAO 2010, pp. 3-6).

Table 1. Illustrative Analytical Process for Identifying Instructional Components

Communication excerpt	Analytical dimension	Analytical interpretation	Derived instructional component
Pilot: "We'll try to let the gear down again and if it remains up and I'm unable to release the nose gear then we'll land with all three up."	(c) Linguistic resources	In reporting the aircraft's abnormal status and intended course of action, the pilot relies on plain English rather than standardized phraseology, which lacks pre-scripted expressions for this specific contingency.	Plain English for abnormal aircraft status reporting
ATC: "You may come for a go-around and visual check of your landing gear"	(b) Communicative function	The controller proposes an operational course of action to support decision-making before landing.	Emergency communication protocols for contingency management
Pilot: "Okay, Roger"	(d) Interactional strategy	The pilot acknowledges receipt of the controller's recommendation without introducing new operational content.	Acknowledgement and response strategies
ATC: "Have you got the field in sight?"	(b) Communicative function	The controller requests information necessary to continue the emergency procedure.	Information exchange and situational confirmation

To enhance the reliability of the categorization process, approximately 20% of the dataset, proportionally representing all seven emergency categories, was independently coded by a co-researcher trained in discourse analysis. Intercoder agreement was calculated using Cohen's kappa (κ = .83), indicating strong agreement (Landis and Koch 1977). Discrepancies were resolved through discussion and consensus before the finalized categories were applied across the full dataset. The outcome of this phase was a structured set of communicative components mapped to each emergency category, informed by both authentic data and the established Aviation English literature.

In the third phase, the communicative components identified through the preceding analyses were systematically organized into a structured instructional content framework for emergency Aviation English. The framework integrates three complementary instructional dimensions: (a) linguistic resources derived from regulatory standards and authentic communication data, (b) communication procedures reflecting established operational practices, and (c) scenario-based learning activities representing authentic emergency situations. Communicative components identified in Phase 2 revealed a recurring progression in the types of knowledge and performance they require. Some components primarily involve declarative knowledge, such as recognizing and recalling category-specific vocabulary. Others require procedural knowledge concerning the sequencing and coordination of communicative moves within operational exchanges. A further group requires repeated, time-pressured practice to develop the fluency necessary for effective emergency communication, whereas the remaining components require the adaptive integration of all preceding competencies under dynamically evolving emergency conditions. This four-part progression is broadly consistent with established theories of skill acquisition, which distinguish declarative knowledge, procedural knowledge, automatization through practice, and integrated performance

(DeKeyser 2007). It also reflects the principle that excessive cognitive load may hinder performance in high-stakes environments unless foundational competencies are consolidated before more complex performance is introduced (Sweller 1988). To support this progression, the three instructional dimensions were organized into four sequential instructional stages: (1) Vocabulary and Pronunciation, (2) Communication Protocol, (3) Practice Activities, and (4) Scenario-Based Simulation. Rather than functioning as independent, self-contained stages, each stage places a different emphasis on the three instructional dimensions while building cumulatively on the competencies developed in the preceding stage. The resulting framework was designed to provide a transferable pedagogical foundation that can be implemented across a range of technology-mediated learning environments. Its content validity was supported through continuous alignment with ICAO standards, authentic pilot-controller communication data, and pedagogical principles identified in the Aviation English literature.

Together, these three phases constitute a systematic, design-oriented procedure for developing a communicatively grounded instructional content framework from authentic operational data. Figure 1 provides an overview of this procedure, illustrating the progression from data collection and emergency classification through communicative component identification to the organization of the final instructional content framework.

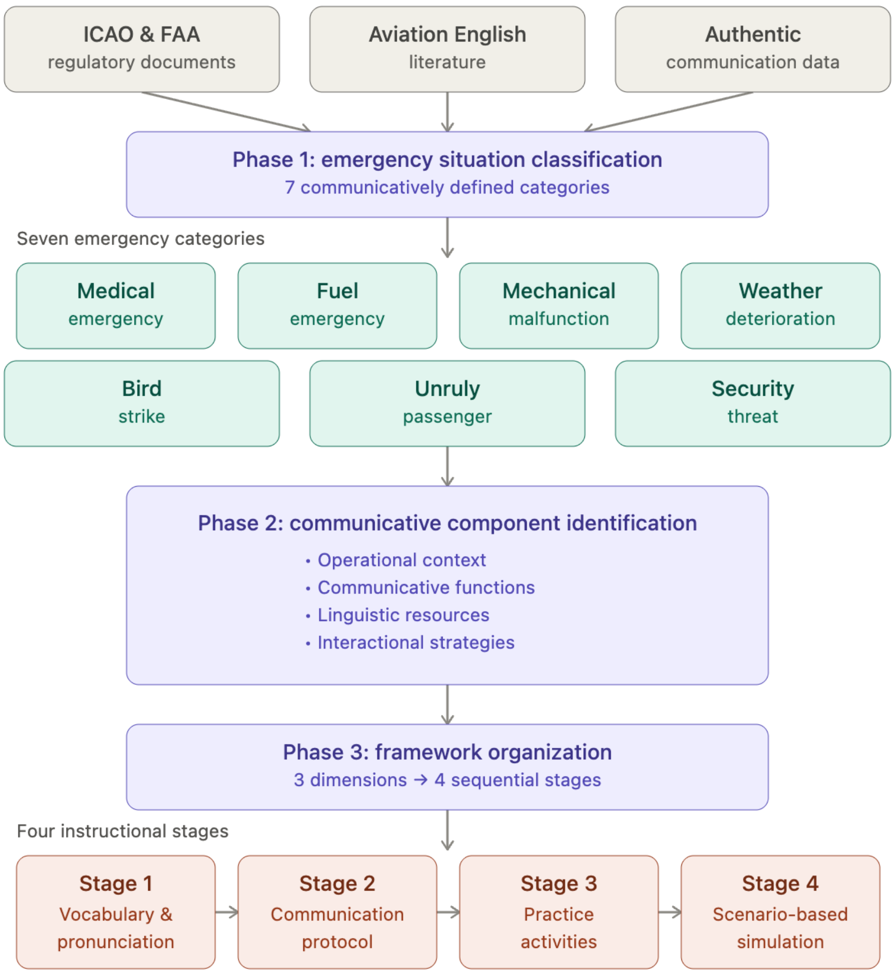

Figure 1. Three Phase Procedure for Developing the Instructional Content Framework for Emergency Aviation English.

4. Results

This study identifies emergency situations relevant to pilot-controller communication and proposes a framework for organizing Aviation English learning materials. First, emergency situations were categorized based on regulatory, operational, and incident-related sources. Building on this classification, a modular framework for Aviation English instruction was then developed to reflect the communicative characteristics and pedagogical requirements associated with each type of emergency.

4.1 Classification of Emergency Situations and their Communicative Characteristics

The analysis resulted in a seven-category classification of emergency situations relevant to pilot-controller communication. Although these categories correspond to operationally recognizable emergency situations, they are distinguished primarily by the communicative demands they impose rather than by technical or operational characteristics alone. Accordingly, the classification reflects differences in the communicative functions, linguistic resources, and interactional characteristics required to manage each type of emergency effectively. Table 2 summarizes the operational characteristics, primary communicative demands, and linguistic resources associated with each category.

While Table 2 summarizes the principal communicative characteristics associated with each emergency category, the analysis also revealed systematic differences in the interactional strategies through which communication is managed under conditions of urgency and uncertainty. Unlike communicative functions, which introduce operational information, interactional strategies regulate the progression of communication itself through acknowledgement, confirmation, clarification, readback, iterative information updates, and the escalation of urgency as situations evolve. Because these strategies are closely shaped by the operational characteristics of each emergency, they are discussed together with the corresponding emergency categories below.

The analysis demonstrated that each emergency category is characterized by a distinct communicative profile requiring different combinations of communicative functions, linguistic resources, and interactional strategies. Medical emergencies, for example, require extensive descriptive reporting because symptoms, patient conditions, and medical requirements cannot be adequately conveyed through standardized radiotelephony phraseology alone. Communication therefore relies heavily on plain English to describe medical conditions accurately while coordinating assistance with air traffic control and ground medical personnel. As patient conditions frequently evolve during flight, interaction is additionally characterized by repeated clarification and confirmation exchanges that enable pilots and controllers to maintain shared situational awareness before appropriate medical assistance can be coordinated.

In contrast, fuel emergencies are characterized by the accurate communication of urgency levels through standardized radiotelephony phraseology. In particular, the progression from minimum fuel advisories to formal emergency declarations such as Mayday or fuel emergency represents a critical communicative threshold because it directly determines the operational priority assigned by air traffic control. The importance of this threshold is demonstrated by the investigation of Avianca Flight 052 (Estival et al. 2016, NTSB 1991). During the flight's final approach, the first officer transmitted the following message to air traffic control: Radio: "… we just ah lost two engines and ah we need priority please." (NTSB 1991, p.13)

Despite having lost two engines because of fuel exhaustion, the crew requested only "priority" rather than issuing a standardized emergency declaration. Air traffic controllers later testified that because the crew never explicitly declared a fuel emergency, the request was not interpreted as an emergency requiring the highest operational priority (NTSB 1991). This example demonstrates not only the importance of standardized terminology but also the interactional necessity of escalating urgency at the appropriate point in the communication sequence once an advisory situation develops into a formal emergency.

Table 2. Classification of Emergency Situations by Communicative Characteristics

Emergency Category	Operational Characteristics	Key Communicative Demands	Linguistic Resources
Medical Emergency	Acute health conditions; requires priority landing and ground medical services	Descriptive reporting of symptoms and patient status; coordination with emergency services; clarification and confirmation exchanges	Descriptive plain English; patient status vocabulary: cardiac arrest, unconscious, severe chest pain, difficulty breathing; coordination terms: paramedic, stretcher, immediate medical attention; extended turns; clarification requests
Fuel Emergency	Advisory (minimum fuel) or distress (Mayday fuel); escalating severity levels	Precise fuel endurance reporting; timely escalation from advisory to emergency declaration; explicit urgency signaling	Standardized terminology: minimum fuel, Mayday; time-based reports; escalation markers; formal distress declarations
Mechanical Malfunction	System failures of varying severity (engine, hydraulic, electrical, flight control)	System-focused status reporting; statement of controllability and operational intent; requests for priority handling	System-identification terms: engine failure, hydraulic failure; brief status updates; supplementary plain English for novel failures
Weather Deterioration	Adverse meteorological conditions during critical flight phases	Dynamic and iterative information exchange; proactive routing requests; real-time condition updates	Weather terms: windshear, icing, turbulence; severity modifiers; integration of standard phraseology and descriptive plain English
Bird Strike	Sudden high-impact event; most often during takeoff/approach; severe time constraints	Rapid, time-compressed communication; concise system-status reporting; immediate emergency declaration when required	Brief system-identification statements; dense, information-compact utterances; explicit controllability and intent markers
Unruly Passenger	Disruptive passenger behaviour threatening onboard safety; no technical system failure	Descriptive situational reporting; coordination with security and medical services; evolving updates as situation develops	Narrative plain English; behavioural description; minimal standard phraseology; requests for law enforcement or medical assistance
Security Threat	Unlawful interference (hijacking, bomb threat, sabotage); highest sensitivity	Restricted, coded, and indirect information exchange; reliance on non-verbal signaling (transponder code 7500); minimal verbal disclosure	Coded/indirect expressions; non-verbal signals; strict adherence to security protocols; strategic restraint in verbal disclosure

Mechanical malfunctions, by comparison, are characterized by concise, system-focused reporting in which information must be transmitted accurately and efficiently under severe time constraints. Communication in these situations depends heavily on prompt acknowledgement and readback of controller instructions because operational decisions frequently require immediate execution. Bird strikes similarly require rapid escalation, but under far greater time pressure, leaving little room for extended clarification. Weather-related emergencies require continuous negotiation as operational conditions evolve, resulting in iterative exchanges through which pilots and controllers repeatedly update, confirm, and revise operational information. Security threats differ from the other emergency categories because operational requirements restrict the amount of information that can be communicated explicitly. Consequently, communication relies primarily on coded signals and non-verbal confirmation, such as transponder code 7500, while verbal exchanges are deliberately minimized to preserve operational security.

Across all seven categories, emergency communication consistently required the integration of standardized radiotelephony phraseology and plain English rather than exclusive reliance on either resource. Standardized phraseology provided the foundation for concise and operationally unambiguous communication, whereas plain English became essential whenever pilots and controllers needed to describe abnormal situations, explain operational constraints, clarify information, or coordinate actions that could not be adequately expressed through fixed phraseology alone. At the same time, successful communication depended on category-specific interactional strategies that enabled participants to establish, maintain, and update shared situational awareness as emergency situations evolved. Taken together, these findings demonstrate that emergency situations differ not only in their operational characteristics but also in the communicative demands they impose on pilots and controllers. Accordingly, the seven categories represent distinct communicative profiles that informed the development of the instructional content framework presented in the following section.

4.2 Development of the Instructional Content Framework

Building on the communicative characteristics identified in Section 4.1, the instructional content framework organizes these components into four sequential instructional stages, following the skill-acquisition rationale detailed in Section 3.3: Vocabulary and Pronunciation, Communication Protocol, Practice Activities, and Scenario-Based Simulation. The framework moves from foundational linguistic knowledge to integrated communicative performance in authentic emergency contexts. An overview of the framework is presented in Table 3.

Table 3. Overview of the Instructional Content Framework

Stage	Instructional Focus	Instructional Organization	Representative Learning Activities
Stage 1 Vocabulary & Pronunciation	Foundational linguistic resources for emergency contexts	Category-specific vocabulary and ICAO-standard pronunciation presented as integrated form-meaning-context units	Vocabulary learning; pronunciation practice; formative vocabulary and pronunciation quizzes
Stage 2 Communication Protocol	Functional organization, sequencing, and prioritization of emergency communication	Category-specific communication protocols organized as functional communication moves integrated with plain-English functions	Annotated pilot-controller exchanges; shadowing practice; communication sequencing analysis
Stage 3 Practice Activities	Procedural fluency and automaticity through rehearsal of discrete communicative skills	Individual rehearsal of vocabulary, pronunciation, and communication protocol through progressively automated practice	Perception and production practice; timed response drills; listening comprehension activities
Stage 4 Scenario-Based Simulation	Integrated communicative performance within authentic, evolving emergency communication	Role-based, category-specific scenario progression integrating vocabulary, communication protocols, and procedural skills	Cue-guided simulation with model comparison and self-evaluation

4.2.1 Stage 1: Vocabulary and pronunciation

This stage establishes the linguistic foundation required for emergency communication by introducing the category-specific vocabulary and pronunciation conventions identified in Section 4.1. Rather than presenting terminology as isolated lexical items, the framework organizes vocabulary according to the communicative characteristics of each emergency category, allowing learners to acquire the linguistic resources needed before engaging in communication-focused activities.

For each emergency category, technical vocabulary is presented through a consistent instructional format comprising pronunciation, a concise definition, a contextualized example sentence derived from authentic or authentically reconstructed pilot-controller communication, and a Korean translation. This organization enables learners to understand each lexical item both as an individual linguistic unit and as part of an operational communication context. Vocabulary learning is further reinforced through formative activities, including English-to-Korean and Korean-to-English matching tasks, as well as sentence-completion exercises in which learners select the vocabulary item that most appropriately completes a contextualized emergency communication example.

Pronunciation instruction begins with the standardized conventions of ICAO radiotelephony, including the pronunciation of numbers (e.g., niner, tree) and the ICAO radiotelephony alphabet, which provide the foundation for intelligible communication across all emergency categories. Building upon these conventions, each vocabulary item is accompanied by its phonetic transcription, stress pattern, and pronunciation guidance. Authentic communication examples are used to demonstrate how these pronunciation features are realized in operational contexts, with learners' attention directed to the specific phonological features most relevant to accurate transmission.

To reinforce pronunciation, the framework incorporates both perception- and production-oriented activities. Learners identify stress placement through listening and visual recognition tasks, distinguish target vocabulary through pronunciation-based listening comprehension, and compare their own speech with model pronunciations provided through synchronized audio. These activities are designed to strengthen both intelligibility and accurate lexical recognition before learners progress to communication protocol training in Stage 2.

Because these linguistic resources serve as the foundation for all subsequent instructional stages, they are designed to remain readily accessible throughout the learning process. Within technology-mediated learning environments, vocabulary entries, pronunciation models, and accompanying explanations may be revisited both before communicative practice and as just-in-time reference resources during later instructional activities.

4.2.2 Stage 2: Communication protocol

This stage addresses how information is structured, sequenced, and prioritized during emergency communication. A distinguishing feature of the framework is that emergency communication is organized around functional communication moves rather than presented as isolated phraseology expressions. Each functional move serves a distinct communicative purpose and carries different operational consequences depending on when and how it is used. Because the communicative demands differ across emergency categories, the specific functional moves and their sequencing also vary accordingly. The medical emergency category is presented here as an illustrative example of how this stage is operationalized.

For the medical emergency category, the communication protocol is organized into six functional moves that are introduced individually before being integrated into a complete pilot-controller exchange: (a) emergency declaration, which establishes the urgency level of the communication and frames the subsequent interaction; (b) identification, specifying the aircraft call sign; (c) situation description, reporting the passenger's condition, relevant symptoms, and actions already taken; (d) statement of intentions, indicating the pilot's intended course of action and providing the basis for subsequent ATC instructions; (e) request for assistance, specifying the support required upon arrival; and (f) readback, confirming accurate reception and understanding of ATC instructions. Other emergency categories are organized in the same manner, although the specific functional moves and their sequencing vary according to the communicative demands of each emergency category.

In addition to the functional communication moves realized through standardized phraseology, the framework explicitly incorporates plain English when fixed phraseology alone cannot adequately convey operationally necessary information. For the medical emergency category, plain-English practice is organized around four communicative functions: describing, providing concrete information about the patient's condition (e.g., "The passenger has lost consciousness and is unresponsive."); explaining, supplying relevant contextual information (e.g., "The passenger has a known allergy and epinephrine has been administered."); requesting, specifying the assistance required (e.g., "We require a stretcher and wheelchair assistance on arrival."); and clarifying, confirming or correcting previously transmitted information (e.g., "To clarify, we need an ambulance, not just medical standby."). Although the specific plain-English content varies across emergency categories, it is consistently organized according to the communicative functions required by each operational context.

To support this learning process, each emergency category includes authentic or authentically reconstructed pilot-controller communication examples illustrating how functional communication moves and plain-English functions are realized within complete operational exchanges. Each utterance is accompanied by synchronized audio playback for shadowing practice, functional annotations identifying its communicative role within the exchange, and Korean translations to facilitate comprehension. By analyzing these annotated exchanges, learners examine how operational information is sequenced, prioritized, and progressively developed throughout the communication, thereby linking individual linguistic forms to their communicative and operational functions before advancing to controlled production activities in Stage 3.

4.2.3 Stage 3: Practice activity

This stage serves as a bridge between the vocabulary, pronunciation, and communication moves developed in the preceding stages and the integrated communicative performance required in Stage 4. Its primary purpose is to develop procedural fluency and automaticity through repeated rehearsal of these foundational skills under controlled conditions, emphasizing the speed, accuracy, and reliability required for time-critical pilot-controller communication.

All activities in this stage are designed for individual, self-directed practice, allowing learners to consolidate discrete communicative skills before engaging in interactive scenario-based tasks. Three complementary activity types constitute the core of this stage. The first activity type is perception and production practice, in which learners listen to model pilot-controller utterances and reproduce them through shadowing and guided repetition. Audio materials are presented with variation in speech rate, accent, and background noise to reflect the diversity of operational communication conditions while reinforcing pronunciation, rhythm, and prosodic features associated with urgency and clarity. The second activity type consists of timed response drills, which develop rapid and appropriate production of communication moves under operational time constraints. Learners hear a scripted prompt, such as an ATC instruction or an emergency trigger, and are required to produce the appropriate response within a five to ten second response window. These drills require learners to retrieve and produce the appropriate communication move independently rather than imitate a model utterance. The third activity type is listening comprehension practice, which complements the production-oriented activities by strengthening learners' ability to recognize and interpret operationally significant information during authentic communication. Learners first listen to a complete pilot-controller exchange and then complete multiple-choice questions targeting the accurate identification of critical information, including the emergency type, aircraft status, operational intentions, or assistance requested. For example, learners identify the assistance requested by the pilot from four alternatives. By repeatedly extracting operationally significant information from authentic exchanges, learners develop the rapid comprehension skills required to support timely and accurate responses during emergency communication.

Taken together, these three activity types provide systematic rehearsal of both receptive and productive communication skills while progressively increasing learners' procedural fluency. Practicing individual communication moves under controlled conditions develops the speed, accuracy, and automaticity learners need to integrate these discrete communication skills within the dynamically evolving emergency scenarios introduced in Stage 4.

4.2.4 Stage 4: Scenario-based simulation

This stage constitutes the culminating component of the instructional content framework, requiring learners to integrate the vocabulary, communication protocols, and procedural skills developed in Stages 1 through 3 within authentic emergency communication. Unlike the preceding stages, which focus on individual linguistic and communicative components, this stage requires learners to coordinate these competencies in combination as emergency situations evolve. Each emergency category comprises multiple scenario variants representing different operational conditions. For example, the medical emergency category includes scenarios involving an unconscious passenger, cardiac arrest, or a suspected infectious disease, each requiring different communicative priorities, vocabulary, and operational responses. Each scenario may be completed from either the pilot's or the controller's perspective.

At the beginning of the simulation, learners are presented with the aircraft call sign and a situational context establishing the emergency scenario. After each learner-produced transmission, a model response based on the same situational cues is provided for comparison, allowing learners to evaluate their own production against target-like example, before the scenario progresses to the next stage of the exchange.

When completing a scenario from the pilot's perspective, learners receive situational cues presented in Korean describing the operational information that must be communicated. Drawing upon the vocabulary, communication protocols, and plain-English resources introduced in the preceding stages, learners produce an appropriate pilot transmission. The corresponding controller response is then presented through pre-recorded audio, requiring learners to comprehend the transmission before producing the next pilot turn. When necessary, an optional transcript may be displayed to provide additional instructional support before the interaction continues.

When completing the same scenario from the controller's perspective, the instructional sequence remains the same, but the order of comprehension and production is reversed. Learners first listen to a pre-recorded pilot transmission, identify the operationally relevant information it conveys, and then produce an appropriate controller response based on the communication protocols introduced in Stage 2. A model controller transmission is subsequently provided for comparison before the next pilot transmission is presented, allowing the interaction to continue until the scenario reaches its conclusion.

By requiring learners to produce successive responses to evolving operational situations, the simulation presents emergency communication as a continuous interaction rather than a series of isolated utterances. Throughout the simulation, model responses enable learners to compare their own production with target-like operational communication, supporting self-evaluation while continuously integrating the linguistic resources, communication protocols, and procedural skills developed throughout the preceding stages.

5. Discussion

The classification developed in this study establishes emergency situations in aviation as a communicatively differentiated set of categories, each imposing distinct operational constraints, communicative functions, linguistic resources, and interactional strategies on pilots and controllers. Medical emergencies require extensive descriptive use of plain English to convey symptoms and patient status, whereas fuel emergencies depend on precise terminology and the timely escalation from advisory to distress declarations. Mechanical malfunctions emphasize concise system-oriented reporting, while security threats impose restrictions on both explicitness and information disclosure. Unlike existing operational taxonomies, which classify emergencies primarily according to technical failures or occurrence types, the present classification organizes emergency situations according to the communicative demands they impose on pilots and controllers. This perspective provides an instructional interpretation of emergency communication that extends beyond the operational focus of ICAO documentation and is consistent with previous calls for greater attention to authentic communicative demands in Aviation English (Estival et al. 2016, Kim and Elder 2009).

This differentiation also extends beyond the broad distinction between routine and non-routine communication that has characterized much previous Aviation English research. Zhao (2024) demonstrated that non-routine radiotelephony constitutes a register that differs systematically from routine communication in its linguistic organization, while Borowska (2017), Friginal et al. (2019, 2020), and Zhao (2023) similarly showed that pilot-controller interaction is shaped by institutional roles, operational contexts, and pragmatic constraints rather than by standardized phraseology alone. The present study supports these observations while extending them by demonstrating that communicative demands also differ systematically within non-routine communication itself. Rather than representing emergency communication as a single instructional category, the classification indicates that different emergency situations require different combinations of communicative functions, linguistic resources, and interactional strategies. Similarly, Ishihara and Prado (2021) argue that successful non-routine communication depends on speakers' ability to adapt their communicative behavior to context. The category-specific communicative profiles identified in the present study provide a more fine-grained instructional interpretation of this principle by specifying how these communicative requirements vary across emergency situations.

Across all emergency categories, communication breakdowns are rarely attributable to insufficient linguistic knowledge alone. Instead, successful emergency communication depends on the ability to perform appropriate communicative actions at the appropriate moment, including initiating emergency declarations, sequencing information according to operational priorities, providing clarification when required, and adapting between standardized phraseology and plain English as situations evolve. This interpretation is consistent with Kim (2023), who found that pilots and controllers meeting minimum ICAO language proficiency requirements nevertheless reported limited confidence in non-routine communication, suggesting that linguistic proficiency alone does not ensure effective operational performance. Similar observations have been reported by Estival et al. (2016), who argue that emergency communication requires speakers to move flexibly between standardized phraseology and plain English according to contextual demands. Taken together, this pattern suggests that effective emergency Aviation English instruction should emphasize not only what learners should say, but also when, why, and how communicative actions should be performed within authentic operational situations.

This classification also carries an implication for vocabulary design that extends beyond the general case for authentic, corpus-derived content. Because the linguistic demands of different emergency categories are structurally distinct, as the classification above demonstrates, a single general-purpose Aviation English vocabulary list risks diluting the specificity that time-critical communication requires. The instructional content framework addresses this by extending situation-specific differentiation to vocabulary design itself: the vocabulary required for a medical emergency is treated as functionally distinct from that required for a fuel emergency, rather than being absorbed into an undifferentiated aviation wordlist. This reflects the broader principle that the appropriate unit of instructional design in emergency Aviation English is the communicative situation rather than the language system in the abstract.

A parallel implication concerns the organization of standardized phraseology itself. Rather than treating ICAO phraseology as a fixed inventory of expressions to be memorized, the framework organizes it as a set of category-specific functional communication moves, each performing a distinct role in structuring an emergency exchange and each carrying a different operational consequence depending on when and how it is used. This design reflects the discourse-analytic view that operational radiotelephony is organized as sequences of institutionally prescribed interactional moves rather than as an undifferentiated inventory of fixed expressions (Nevile 2004, Zhao 2023), and suggests that Aviation English instruction should train learners not only to produce phraseology accurately but to recognize the communicative function each expression performs within an unfolding exchange.

The instructional organization proposed in this study further provides a pedagogically meaningful interpretation of these communicative findings. Rather than treating vocabulary learning, communication procedures, practice, and simulation as independent instructional elements, the framework organizes them into a progressive sequence in which each stage provides the foundation for the next. This progression reflects the increasing communicative complexity of emergency communication itself. Learners first acquire the linguistic resources needed to recognize and describe emergency situations, then learn how these resources are organized into functional communication protocols before developing procedural fluency through repeated rehearsal. Only after these component skills have been consolidated are learners required to coordinate them within integrated scenario-based communication. This staged organization follows the skill-acquisition rationale outlined earlier, ensuring that learners enter integrated simulation already equipped with consolidated component skills rather than acquiring them for the first time under the cognitive demands of an open-ended task.

This framework likewise provides an instructional perspective on recent developments in technology-mediated Aviation English education. Previous simulation-based studies have demonstrated that immersive learning environments can improve learners' vocabulary knowledge, communicative performance, and confidence in emergency communication (e.g., Demirdöken and Atay 2024). However, these studies have generally evaluated instructional technologies without specifying how emergency communication content should be systematically organized within them. The present framework addresses this gap by identifying the communicative content, instructional progression, and interactional demands that such learning environments should incorporate. Importantly, the framework retains explicit stages targeting vocabulary acquisition and readback fluency (Stages 1 and 3) while extending instruction toward interactional competence through communication protocols and scenario-based performance. In this respect, the proposed framework is intended to build upon rather than replace the foundational gains demonstrated by Demirdöken and Atay (2024). Whether this broader instructional design also produces comparable improvements in vocabulary knowledge and readback performance, however, remains an open empirical question that lies beyond the scope of the present design and development study and requires direct evaluation through future implementation research. The framework's emphasis on voice-based interaction further reflects the modality-specific characteristics of operational radiotelephony, supporting closer alignment between instructional activities and the communicative conditions encountered in actual pilot-controller communication (Barshi and Farris 2013).

Beyond its immediate application to Aviation English, the proposed framework reflects a broader design principle within English for Specific Purposes (ESP). Rather than organizing instruction around generalized language skills, it derives instructional content from the authentic communicative demands of target professional situations. This approach aligns closely with the central objective of ESP, in which instructional design is driven by the communicative requirements of particular professional communities. From this perspective, the framework may also inform instructional design for technology enhanced communication training in other high stakes operational domains. For example, military English instruction could distinguish routine operational coordination from combat or casualty evacuation communication, while emergency medical communication could differentiate trauma triage, cardiac emergencies, and inter facility patient handoffs according to their distinct communicative demands. In each case, effective instructional design depends not simply on teaching domain specific language, but on organizing communicative functions, linguistic resources, and interactional strategies according to the demands of specific operational situations.

6. Conclusion

This study developed a structured instructional content framework for emergency Aviation English, grounded in a systematic classification of seven communicatively defined emergency categories and organized into a four-stage instructional sequence. Drawing on regulatory documents, authentic pilot-controller communication data, and established pedagogical principles, the framework reconceptualizes emergency Aviation English as a domain of context-dependent interaction rather than an extension of routine radiotelephony. The resulting classification demonstrates that emergency categories differ systematically in their communicative functions, linguistic resources, and interactional strategies. These communicative differences are subsequently organized into a four-stage instructional content framework that responds to category-specific communicative demands while providing a coherent pedagogical structure for technology-mediated emergency communication training.

The study contributes to Aviation English pedagogy by providing a systematic instructional content framework that moves beyond generalized vocabulary lists and routine-oriented phraseology training toward communicatively organized emergency communication. It also contributes to technology enhanced language learning by demonstrating that the educational value of immersive and simulation-based learning environments depends not only on technological sophistication but also on the systematic organization of instructional content. More broadly, the framework illustrates how instructional content can be organized around the authentic communicative demands of professional practice, offering a design approach that may inform technology enhanced communication training in other high stakes operational domains.

Several limitations should be acknowledged. Consistent with the purpose of this study, the focus was on the systematic development of an instructional content framework rather than on its empirical validation. Consequently, the framework has not yet been evaluated through expert review or learner implementation, and its effectiveness in supporting emergency communication remains to be established. The present study should therefore be regarded as a foundational phase that establishes the instructional content basis for future development. Future research should implement and evaluate the framework in technology-enhanced learning environments to examine its pedagogical validity, learner engagement, communicative performance, and transfer to operational communication. Such research will further refine the proposed framework and contribute to the development of evidence-based, communicatively grounded approaches to emergency Aviation English instruction.

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Examples in: English
Applicable Languages: English
Applicable Level: Tertiary