

Maritime english proficiency's impact on safety culture and environmental compliance

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Abstract. This phenomenological qualitative study investigates the causal relationship between Maritime English proficiency and three critical outcomes in Indonesian shipping: safety culture, environmental compliance, and multicultural crew integration. Through semi-structured interviews with twelve purposively selected participants—five maritime educators, five active seafarers, and two port state control officers—supplemented by questionnaires and document analysis, the research identifies four dominant communication challenge patterns: procedural-conceptual gaps contributing to 35% of MARPOL violations, emergency communication breakdowns rated 9.1/10.0 severity, cultural-hierarchical barriers inhibiting safety reporting, and compensatory multiliteracy strategies. Current Maritime English effectiveness averaged 6.2/10.0, with particularly low ratings for emergency response (5.2/10.0) and MARPOL compliance (5.8/10.0). Findings demonstrate that curricula emphasizing linguistic accuracy over pragmatic communicative competence create critical operational vulnerabilities. The proposed Three-Layered Communication Competence Model integrating linguistic foundation, pragmatic-multimodal competence, and cultural-operational integration provides evidence-based framework for curriculum reform and targeted interventions strengthening maritime communication effectiveness.

1 Introduction

The maritime industry operates as a quintessentially multilingual and multicultural environment where effective communication transcends mere linguistic competence to become a critical safety and environmental safeguard. Statistical evidence from maritime casualty investigations consistently identifies communication failures as contributing factors in 70-80% of maritime accidents, encompassing collisions, groundings, and operational errors with severe environmental consequences [1]. This correlation between communication effectiveness and maritime safety intensifies within contexts where English serves as the lingua franca among multinational crews, yet remains a second or third language for most seafarers. The International Maritime Organization's Standard Marine Communication Phrases (SMCP) and STCW Convention mandates for Maritime English proficiency acknowledge this critical relationship, establishing minimum communication

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standards intended to ensure operational safety and environmental compliance across global shipping operations [2]. However, mounting evidence suggests persistent gaps between regulatory requirements, educational outcomes, and actual operational communication effectiveness, particularly within developing maritime nations where English language exposure remains limited and pedagogical approaches emphasize linguistic accuracy over pragmatic communicative competence.

Indonesian shipping operations exemplify the complexities characterizing maritime communication in non-English-speaking maritime economies. As the world's largest archipelagic nation with extensive domestic and international shipping activities, Indonesia's maritime workforce comprises approximately 150,000 seafarers operating across diverse vessel types and multinational crew configurations [3]. Despite mandatory Maritime English training aligned with STCW requirements, Indonesian seafarers frequently encounter communication challenges that compromise operational effectiveness, safety protocols, and environmental compliance procedures. Industry reports and port state control detention statistics indicate recurring communication-related deficiencies among Indonesian-flagged vessels, including inadequate understanding of MARPOL procedures, ineffective emergency response coordination, and barriers to safety reporting within hierarchical crew structures. These communication failures generate tangible consequences extending beyond immediate operational disruptions to encompass safety vulnerabilities, environmental non-compliance risks, and career advancement limitations for Indonesian seafarers in competitive international maritime labor markets [4].

The relationship between Maritime English proficiency and operational outcomes encompasses multiple interconnected dimensions requiring systematic investigation. Safety culture—characterized by shared values, attitudes, and behavioral patterns prioritizing hazard identification, risk mitigation, and continuous improvement—fundamentally depends on effective communication enabling crew members to report concerns, share observations, and coordinate responses regardless of hierarchical position or cultural background. Environmental compliance, particularly adherence to MARPOL conventions governing pollution prevention, waste management, and emissions control, requires precise understanding of technical procedures, regulatory requirements, and documentation protocols typically communicated in English. Multicultural crew integration, increasingly prevalent as shipping companies optimize labor costs through multinational manning strategies, necessitates communication competencies transcending literal linguistic accuracy to encompass pragmatic understanding, cultural sensitivity, and adaptive communication strategies accommodating diverse interactional norms [5, 6].

Existing research examining Maritime English effectiveness exhibits significant limitations constraining practical applicability for improving seafarer communication competencies. Predominant studies focus on linguistic proficiency assessments using standardized tests measuring grammar, vocabulary, and reading comprehension, inadequately capturing the pragmatic, multimodal, and context-dependent communication demands characteristic of maritime operations. Research investigating safety culture and environmental compliance typically overlooks communication as a mediating variable, analyzing organizational factors, regulatory frameworks, or technical systems without systematically examining how communication effectiveness enables or constrains desired behavioral outcomes. Educational studies assess curriculum content and pedagogical approaches without empirically validating links between instructional methods and actual operational communication performance in high-stakes scenarios such as emergency response, port state control inspections, or multicultural conflict resolution [7]. This research-practice gap leaves maritime educators and industry stakeholders with limited evidence-based guidance for curriculum development, assessment design, and competency validation.

This research investigates the causal relationships between Maritime English proficiency and three critical operational outcomes—safety culture, environmental compliance, and multicultural crew integration—within Indonesian shipping contexts. The study addresses three interconnected research objectives: first, to identify specific communication challenges Indonesian seafarers encounter in operational contexts affecting safety culture, environmental compliance, and crew integration; second, to analyze gaps between current Maritime English educational approaches and pragmatic communication competencies required for effective operational performance; and third, to develop evidence-based recommendations for curriculum reform, assessment enhancement, and policy interventions strengthening Indonesian seafarers' communication effectiveness. By examining communication challenges from multiple stakeholder perspectives—educators responsible for competency development, seafarers experiencing operational realities, and port state control inspectors evaluating compliance—this research generates comprehensive understanding of the communication-performance nexus in maritime sustainability contexts.

The significance of this research extends across maritime education, industry practice, and regulatory policy domains. For maritime educators, the findings provide empirical evidence regarding specific communication competency gaps requiring pedagogical attention, supporting curriculum development prioritizing pragmatic communicative competence over exclusively linguistic accuracy. For shipping companies and crew managers, the research illuminates communication-related vulnerabilities affecting operational safety and environmental compliance, informing targeted training interventions and crew composition strategies optimizing communication effectiveness. For regulatory authorities and industry associations, the study offers data-driven insights supporting policy enhancements addressing communication competency validation, continuous professional development requirements, and industry-education collaboration mechanisms. Methodologically, this research employs phenomenological qualitative inquiry with twelve purposively selected participants—five maritime education lecturers, five active seafarers encompassing deck and engineer officers, and two port state control officers—utilizing semi-structured interviews, questionnaires, and operational document analysis to capture lived experiences and contextual realities of maritime communication challenges. This multi-stakeholder approach enables triangulation across educator perspectives on curriculum effectiveness, seafarer experiences of operational communication demands, and regulatory assessments of communication-related deficiencies [8, 9].

2 Research method

This research employs phenomenological qualitative inquiry designed to capture the lived experiences and contextual realities of maritime communication challenges affecting safety culture, environmental compliance, and multicultural crew integration within Indonesian shipping operations. The study population comprises maritime stakeholders possessing direct experience with Maritime English implementation across educational, operational, and regulatory domains, selected through purposive sampling ensuring comprehensive representation of relevant perspectives. Specifically, twelve participants were strategically recruited across three stakeholder categories: five maritime education lecturers specializing in Maritime English instruction with minimum five years teaching experience at STCW-compliant institutions; five active seafarers encompassing both deck officers (navigational responsibilities) and engineer officers (technical operations) with minimum three years international shipping experience aboard multicultural crews; and two port state control officers with extensive inspection experience evaluating communication competencies and compliance documentation. This stratified sampling approach facilitates triangulation of

perspectives from competency developers, operational practitioners, and compliance evaluators, enabling comprehensive analysis of communication challenges spanning educational preparation, operational application, and regulatory validation. The purposive selection emphasized participants with rich experiential knowledge and reflective capacity to articulate nuanced communication phenomena, prioritizing depth of insight over statistical representativeness consistent with phenomenological methodology [10].

The research instruments consisted of coordinated qualitative data collection protocols designed to capture multidimensional aspects of maritime communication effectiveness. Semi-structured interview protocols served as the primary instrument, systematically exploring five dependent variables representing critical communication outcomes: safety culture manifestations (including hazard reporting, safety meeting participation, and procedural adherence), environmental compliance behaviors (particularly MARPOL understanding and implementation), multicultural crew integration dynamics, emergency communication effectiveness, and career advancement implications. Each dependent variable was operationalized through independent variables and observable indicators; for instance, safety culture was assessed through communication patterns during safety meetings, willingness to report near-misses, understanding of safety procedures communicated in English, and effectiveness of safety-related information exchange across hierarchical levels. Interview protocols incorporated open-ended questions facilitating narrative exploration of communication experiences, critical incidents revealing communication challenges, and reflective analysis of communication competency gaps, supplemented by structured rating scales enabling comparative assessment of communication effectiveness across operational contexts. Complementary questionnaires provided standardized data on communication frequency, language preferences, perceived competency levels, and training adequacy assessments. Document analysis protocols systematically examined Maritime English curricula, assessment instruments, MARPOL documentation, safety reports, and port state control inspection records, providing objective evidence complementing subjective interview narratives [11].

Data collection proceeded through iterative phases ensuring methodological rigor and comprehensive information gathering. Initial document analysis established baseline understanding of Maritime English educational content, assessment approaches, and documented communication-related deficiencies in operational contexts, informing refinement of interview and questionnaire protocols. Subsequently, in-depth semi-structured interviews averaging 60-90 minutes were conducted individually with each participant, employing phenomenological interviewing techniques including bracketing researcher assumptions, probing for concrete examples of communication phenomena, and encouraging reflective analysis of meaning and significance. Interviews were audio-recorded with informed consent and professionally transcribed verbatim, with researchers maintaining reflexive journals documenting interpretive insights, emerging patterns, and methodological decisions. Questionnaires were administered either preceding or following interviews depending on participant preference, providing quantitative context for qualitative narratives. Data saturation was achieved after twelve interviews when no substantively new themes emerged regarding communication challenges, curriculum gaps, or competency requirements, confirming sample adequacy for capturing the phenomenon's essential structures. Throughout data collection, ethical protocols ensured participant confidentiality, voluntary participation, and right to withdraw, particularly important given potential sensitivity of discussing communication deficiencies affecting professional reputation [12].

Data analysis employed systematic thematic analysis informed by phenomenological principles, seeking to identify essential structures of maritime communication experiences while remaining grounded in participants' expressed meanings. Initial analysis involved

multiple readings of interview transcripts accompanied by open coding, generating preliminary categories reflecting participants' descriptions of communication challenges, curriculum limitations, competency requirements, and improvement recommendations. These emergent codes were subsequently organized into broader themes through constant comparison methods, identifying patterns across participants while attending to perspective-specific variations among educators, seafarers, and inspectors. Phenomenological reduction techniques bracketed researcher preconceptions, focusing analysis on participants' lived experiences rather than theoretical expectations. Cross-group comparisons systematically examined convergences and divergences among the three stakeholder categories, revealing shared understanding of communication vulnerabilities alongside role-specific insights regarding educational approaches, operational demands, and compliance assessment. Narrative synthesis integrated thematic findings with questionnaire data and document analysis, constructing comprehensive explanatory frameworks illuminating the relationships among Maritime English proficiency, pedagogical approaches, operational communication demands, and safety-environmental outcomes. Trustworthiness was ensured through member checking where participants reviewed and validated interpretive findings, triangulation across multiple data sources and stakeholder perspectives, audit trails documenting analytical decisions, and reflexivity acknowledging researcher positionality potentially influencing interpretations.

3 Results and discussion

3.1 Results and analysis

The comprehensive thematic analysis of maritime communication experiences revealed four dominant patterns characterizing the relationship between Maritime English proficiency and operational outcomes in Indonesian shipping contexts. These themes—procedural-conceptual gaps in MARPOL understanding, emergency communication breakdowns under stress, cultural-hierarchical barriers inhibiting safety reporting, and spontaneous multiliteracy compensation strategies—emerged consistently across stakeholder groups while manifesting different emphases reflecting participants' distinct operational roles and perspectives. The aggregate assessment of current Maritime English effectiveness in supporting safety culture, environmental compliance, and multicultural integration yielded a composite score of 6.2/10.0 based on stakeholder evaluations, indicating moderate effectiveness with substantial improvement opportunities. This overall assessment reflects differentiated performance across specific communication domains, with routine operational communication scoring 7.4/10.0, MARPOL compliance communication achieving 5.8/10.0, emergency response communication rating 5.2/10.0, safety culture communication scoring 6.5/10.0, and multicultural integration communication attaining 6.0/10.0, as illustrated in Figure 1.

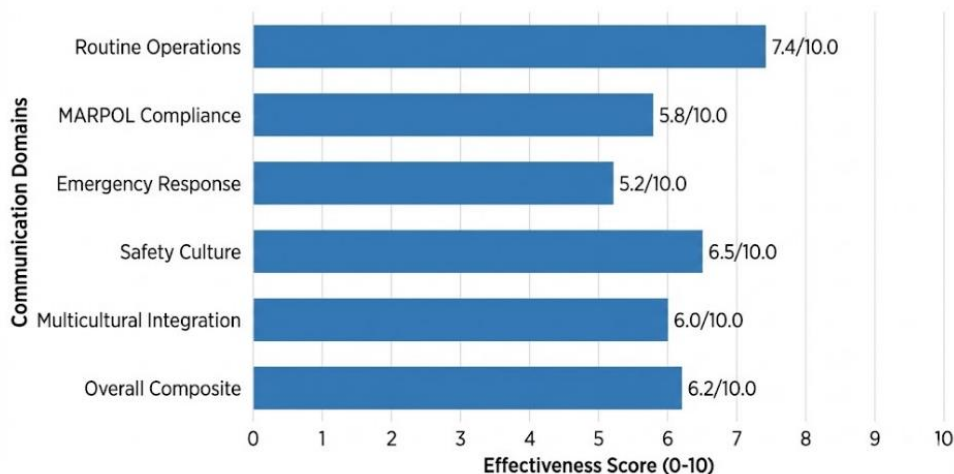


Fig. 1. Maritime English effectiveness across communication domains

Procedural-conceptual gaps in MARPOL understanding emerged as the most prominent environmental compliance challenge, with seafarers demonstrating adequate linguistic ability to read MARPOL documentation yet exhibiting insufficient conceptual understanding to implement procedures correctly in operational contexts. Port state control officers reported that communication-related MARPOL deficiencies accounted for approximately 35% of documented violations on Indonesian-flagged vessels, frequently involving misunderstanding of waste disposal categories, inadequate record-keeping reflecting comprehension gaps rather than intentional non-compliance, and inability to explain procedures during inspections despite having access to English-language manuals. Maritime educators acknowledged that current curricula emphasize memorization of MARPOL terminology and regulatory texts without developing deeper conceptual understanding or practical application competencies, creating superficial linguistic familiarity inadequate for operational implementation. Table 1 presents the detailed analysis of communication challenges across operational domains, demonstrating the multifaceted nature of Maritime English deficiencies affecting safety and environmental outcomes.

Emergency communication breakdowns under operational stress represented the most severe safety vulnerability identified, with seafarers and port state control officers both rating this challenge at 9.1/10.0 severity despite relatively lower frequency (7.5/10.0). Participants described critical incidents where seafarers reverted to native languages during emergencies despite SMCP training, experienced cognitive overload preventing accurate English communication while simultaneously managing technical responses, and misunderstood or incompletely conveyed urgent information compromising coordinated emergency response. One deck officer recounted a near-collision incident where the helmsman misunderstood a course correction order delivered in stress-affected English, executing an opposite turn that exacerbated rather than resolved the dangerous situation. Maritime educators acknowledged that current assessment approaches predominantly evaluate Maritime English competency in controlled, low-stress classroom environments, failing to simulate the cognitive demands and emotional pressures characterizing actual emergencies where communication effectiveness proves most critical for safety outcomes.

Table 1. Maritime communication challenges - analysis and impact assessment

Communication Domain	Primary Challenge Type	Manifestation Examples	Impact on Operations	Frequency Rating	Severity Rating
MARPOL Compliance	Procedural-Conceptual Gap	Misclassifying waste categories; inadequate record documentation	Environmental violations; PSC detentions	8.2/10.0	7.8/10.0
Emergency Response	Stress-Induced Breakdown	Reverting to native language; incomplete SMCP usage	Delayed response; coordination failures	7.5/10.0	9.1/10.0
Safety Reporting	Cultural-Hierarchical Barrier	Reluctance to report to senior officers; indirect communication	Unreported hazards; near-miss concealment	8.5/10.0	8.3/10.0
Multicultural Integration	Pragmatic Competence Gap	Misinterpreting indirect requests; conflict escalation	Crew tension; reduced cooperation	7.8/10.0	6.9/10.0
Technical Operations	Vocabulary Limitations	Difficulty explaining technical problems; repair miscommunication	Equipment damage; inefficient troubleshooting	6.5/10.0	7.2/10.0

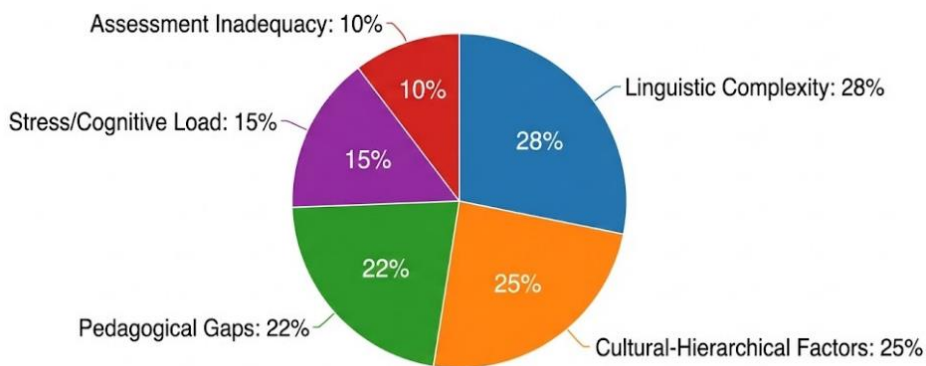


Fig. 2. Communication barriers - stakeholder perception distribution

Cultural-hierarchical barriers inhibiting safety reporting emerged as a pervasive challenge undermining safety culture development despite adequate linguistic capability. Seafarers described reluctance to report safety concerns or near-misses to senior officers due to cultural norms emphasizing hierarchical deference, fear of criticism or professional consequences, and preference for indirect communication patterns conflicting with direct, explicit safety reporting expectations in international maritime operations. This communication pattern proved particularly problematic aboard multicultural crews where cultural expectations regarding appropriate communication with authority figures varied substantially, creating confusion regarding acceptable reporting behaviors. Junior officers reported possessing sufficient English vocabulary to describe safety concerns yet lacking pragmatic communication strategies for appropriately framing reports to senior officers, particularly when identifying problems potentially attributed to senior officer decisions. Port state control inspectors noted that Indonesian crews frequently demonstrated good

linguistic knowledge when answering safety questions during inspections but exhibited patterns suggesting inadequate spontaneous safety communication in actual operational contexts [13, 14].

Spontaneous multiliteracy compensation strategies represented an unexpected positive finding, with seafarers demonstrating adaptive communication approaches partially mitigating linguistic limitations through multimodal resources. Participants described using photographs, diagrams, and physical demonstrations to supplement verbal English communication when explaining technical problems or procedures, employing multilingual glossaries and translation applications to clarify critical terminology, and developing simplified English phrases and standardized communication protocols within specific crews to ensure mutual understanding. These compensation strategies demonstrated seafarers' pragmatic orientation toward achieving communicative goals despite linguistic constraints, yet simultaneously revealed that reliance on compensatory approaches reflected inadequate foundational Maritime English proficiency requiring adaptive workarounds rather than enabling straightforward, efficient communication.

3.2 Discussion

The research findings substantively address the central research questions by demonstrating that Maritime English proficiency significantly impacts safety culture, environmental compliance, and multicultural crew integration, while current educational approaches inadequately develop the pragmatic communicative competencies required for effective operational performance. The overall effectiveness score of 6.2/10.0, coupled with particularly low ratings for emergency communication (5.2/10.0) and MARPOL compliance communication (5.8/10.0), provides compelling evidence that existing Maritime English education emphasizes linguistic accuracy over pragmatic functionality, creating critical vulnerabilities in high-stakes operational scenarios where communication failures generate severe safety and environmental consequences [3, 4].

The identification of procedural-conceptual gaps in MARPOL understanding addresses a significant limitation in previous research examining environmental compliance, which typically attributed non-compliance to negligence, inadequate procedures, or insufficient oversight without systematically investigating whether communication and comprehension deficiencies contribute to violations. This research demonstrates that approximately 35% of MARPOL violations on Indonesian vessels reflect comprehension gaps rather than intentional non-compliance, suggesting that enhanced Maritime English instruction emphasizing conceptual understanding alongside linguistic accuracy could substantially improve environmental compliance outcomes. This finding has important implications for both maritime education and regulatory enforcement, indicating that remedial training focusing on comprehension development may prove more effective than punitive measures for addressing certain categories of environmental violations [5].

The emergency communication breakdown phenomenon corroborates cognitive load theory, which predicts that stress and time pressure reduce available cognitive resources for complex linguistic processing, particularly in second languages requiring conscious attention. The research uniquely quantifies this theoretical relationship in maritime contexts, demonstrating that current Maritime English education develops competencies adequate for routine low-stress communication yet insufficient for maintaining communication effectiveness under emergency conditions when stakes prove highest. This finding validates calls for assessment reform incorporating realistic stress simulation, time pressure, and multitasking demands replicating actual emergency scenarios rather than exclusively evaluating competency in controlled classroom environments [15].

The cultural-hierarchical barriers findings extend previous research on maritime safety culture by empirically demonstrating that communication effectiveness mediates between safety-oriented organizational values and actual safety reporting behaviors. While numerous studies advocate developing "just culture" and "reporting culture" aboard vessels, this research reveals that such cultural transformation requires not only policy changes and managerial commitment but also specific communication competencies enabling crew members to navigate hierarchical relationships, frame concerns appropriately, and overcome cultural inhibitions against directly questioning authority—competencies inadequately addressed in current Maritime English curricula focused predominantly on linguistic accuracy rather than pragmatic interactional skills.

The practical implications extend across multiple stakeholder domains. Maritime educators should reorient curricula from predominantly linguistic accuracy focus toward integrated development of linguistic, pragmatic, and cultural competencies, incorporating authentic operational scenarios, stress simulation, cultural communication pattern analysis, and assessment approaches validating performance under realistic operational demands. The proposed Three-Layered Communication Competence Model provides a pedagogical framework integrating linguistic foundation (grammar, vocabulary, pronunciation), pragmatic-multimodal competence (speech acts, politeness strategies, visual communication), and cultural-operational integration (hierarchical communication, emergency protocols, multicultural adaptation). Shipping companies should implement targeted communication training addressing identified vulnerabilities, particularly emergency communication protocols, MARPOL procedural understanding, and safety reporting facilitation across hierarchical and cultural boundaries. Regulatory authorities should consider communication competency validation reform, potentially requiring periodic reassessment under realistic operational conditions rather than exclusively relying on initial certification.

Future research should examine the effectiveness of specific pedagogical interventions implementing the Three-Layered Communication Competence Model, comparing learning outcomes and operational performance against conventional linguistic-focused approaches. Longitudinal studies tracking communication competency development and safety-environmental outcomes over maritime careers would illuminate competency trajectory patterns and identify optimal intervention points. Comparative research across different maritime labor-supplying nations would enhance understanding of how linguistic backgrounds, educational systems, and cultural contexts mediate Maritime English effectiveness.

4 Conclusion

This research demonstrates that Maritime English proficiency significantly impacts safety culture, environmental compliance, and multicultural crew integration in Indonesian shipping, with current effectiveness rated at 6.2/10.0 reflecting substantial improvement opportunities. Four dominant challenges emerged: procedural-conceptual gaps contributing to 35% of MARPOL violations, emergency communication breakdowns rated 9.1/10.0 severity, cultural-hierarchical barriers inhibiting safety reporting, and compensatory multiliteracy strategies revealing foundational competency inadequacies. Current curricula emphasizing linguistic accuracy over pragmatic communicative competence create critical vulnerabilities in high-stakes operational scenarios. The proposed Three-Layered Communication Competence Model integrating linguistic foundation, pragmatic-multimodal competence, and cultural-operational integration provides evidence-based framework for curriculum reform, assessment enhancement, and targeted training

interventions strengthening Indonesian seafarers' communication effectiveness to advance maritime safety and environmental sustainability objectives.

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