

UDC 811.111'276:378:656.61:004

DOI <https://doi.org/10.12958/3083-6514-2026-1-153-159>

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INNOVATIVE TECHNOLOGIES IN MARITIME ENGLISH LEARNING: A THEORETICAL ANALYSIS OF THE DEVELOPMENT OF PROFESSIONAL COMMUNICATIVE COMPETENCE OF FUTURE DECK OFFICERS

The rapid digitalization of the maritime industry and the increasing complexity of shipboard operations have significantly raised the demands on the communicative competence of future deck officers. Maritime English, as the primary medium of international maritime communication, plays a crucial role in ensuring safety, coordination, and efficiency in multicultural crews. However, traditional teaching approaches often fail to fully address the dynamic linguistic needs of modern seafarers, especially in situations requiring precise, standardized, and timely communication.

At the same time, innovative educational technologies, including simulation-based learning, digital platforms, interactive multimedia tools, and AI-enhanced language environments, offer new opportunities to improve the acquisition of Maritime English. Despite their potential, there remains a lack of comprehensive research that analyzes how these technologies influence the development of professional communicative competence and whether they effectively prepare cadets for real shipboard interactions.

The problem is further intensified by the growing gap between classroom-based language instruction and real maritime communicative practices defined by IMO standards and contemporary operational realities. This gap underscores the need to re-evaluate teaching methodologies and integrate technology-enhanced strategies capable of replicating authentic shipboard scenarios.

Therefore, the central problem addressed in this study is the insufficient understanding of how innovative technologies can transform the teaching of Maritime English and contribute to improving the professional communication skills of future deck officers. This issue is directly related to the broader scientific and practical task of enhancing maritime safety, improving crew performance, and aligning maritime education with international requirements and the technological evolution of the maritime sector.

Recent research highlights the growing importance of innovative technologies in Maritime English instruction for developing professional communicative competence among future deck officers. Simulator-based and VR-enhanced training has been shown to provide realistic, high-fidelity environments in which cadets can practice Standard Marine Communication Phrases (SMCP) and collaborative decision-making under time pressure, effectively bridging the gap between classroom instruction and shipboard operations (Kim et al., 2021; Tovstokoryi & Popova, 2021). Corpus-based analyses and systematic needs assessments further support the design of targeted instructional materials by identifying frequently used lexical bundles, phraseology, and pragmatic patterns in authentic maritime communication, ensuring that course content reflects operational realities and the demands of multicultural crews (Diahyleva et al., 2021; Tymoshchuk, 2024). At the same time, EdTech, AI-driven tools, and blended learning models offer personalized learning opportunities,

enhancing engagement, motivation, and the acquisition of professional language skills, though challenges such as curriculum integration, instructor training, and alignment with IMO standards remain (Guz, 2024). Despite the promising outcomes of these approaches, gaps persist in longitudinal evidence, comparative analyses of different technological interventions, and large-scale evaluation of their effectiveness in real maritime settings. Building on these studies, the present research aims to systematically examine how simulators, VR/AI applications, and digital learning platforms contribute to the development of professional communicative competence, providing an evidence-based framework for integrating innovative educational technologies into maritime English curricula in alignment with international standards.

Despite the growing body of research on simulator-based training, VR/AI applications, corpus-informed instruction, and digital learning platforms in Maritime English education, several critical aspects of the general problem remain insufficiently addressed. First, there is a lack of longitudinal studies examining the sustained impact of technology-enhanced learning on professional communicative competence over extended periods of cadet training or into early shipboard practice. Second, comparative analyses of different technological interventions, such as traditional simulation versus VR-based or blended learning approaches, are limited, leaving unclear which combinations of tools yield the most effective results under realistic operational conditions. Third, while corpus-based and needs-analysis methods provide valuable guidance for curriculum design, their integration into classroom practice and alignment with IMO communication standards remain inconsistent. Fourth, the challenges of instructor readiness, curriculum adaptation, and validated assessment tools for evaluating language performance in technology-rich environments have not been systematically addressed. Finally, there is a shortage of studies investigating the interaction between multiple innovations (simulators, VR, AI, and digital platforms) in a coordinated pedagogical framework, which is crucial for ensuring that cadets acquire practical, high-stakes communication skills required for safe and efficient shipboard operations.

This article is therefore dedicated to examining these unresolved aspects by systematically evaluating how innovative educational technologies can be integrated and optimized to enhance Maritime English learning and professional communicative competence in alignment with operational standards and international regulations.

The aim of this study is to systematically examine the role of innovative educational technologies, including simulators, virtual reality (VR), AI-supported tools, and digital learning platforms, in enhancing professional communicative competence of future deck officers through Maritime English instruction, ensuring alignment with IMO standards and operational requirements.

The present study employs a theoretical and analytical methodology, focused on synthesizing existing literature and conceptual frameworks related to innovative educational technologies in Maritime English instruction. A systematic analysis of research articles, case studies, and pedagogical reports on simulator-based training, virtual reality, AI-assisted learning, and digital platforms was conducted to identify key trends, advantages, limitations, and theoretical implications. Comparative evaluation of different instructional strategies allowed assessment of their alignment with IMO standards and potential effectiveness in enhancing professional communicative competence. Findings from multiple sources were synthesized to derive general principles, identify recurring themes, and highlight gaps and unresolved issues in previous studies. Units of analysis include theoretical models of technology-enhanced Maritime English instruction, published studies on digital and simulation tools, and conceptual frameworks for professional language competence, providing a foundation for evidence-based recommendations and future empirical research.

The theoretical analysis of contemporary literature demonstrates that innovative educational technologies represent a crucial dimension in the development of professional communicative competence in Maritime English instruction. Simulator-based training, including bridge simulators

and VR-enhanced environments, is consistently identified as one of the most effective tools for replicating the operational and linguistic realities of shipboard communication (Kim et al., 2021; Tovstokoryi & Popova, 2021). Such immersive environments allow cadets to practice Standard Marine Communication Phrases (SMCP), emergency communication protocols, and collaborative decision-making under conditions that closely approximate real-life maritime operations. The literature highlights that repeated exposure to realistic scenarios facilitates cognitive and linguistic skill development, reinforcing the principle that experiential and contextualized learning is more effective than traditional classroom-based approaches. Immersion in simulation not only improves accuracy and clarity but also enhances situational appropriateness, response time, and adaptability in high-stakes situations, which are essential attributes for future deck officers.

Corpus-informed and needs-analysis-based approaches provide a complementary theoretical foundation. Research by Diahyleva, Yurzenko & Kononova (2021) and Tymoshchuk (2024) demonstrates that analyzing spoken and written maritime corpora allows educators to identify frequently used lexical bundles, pragmatic patterns, and professional phraseology essential for shipboard communication. These insights inform curriculum design and the selection of learning materials, ensuring that instructional content reflects the authentic language demands of modern maritime practice. By integrating corpus-based findings with the operational standards set by the International Maritime Organization (IMO), educational programs can theoretically increase the functional relevance of the learning experience, enhance retention, and better prepare cadets for interaction within multicultural crews. Needs analysis further ensures that learners' proficiency development is aligned with specific linguistic and operational requirements, addressing the discrepancy often observed between traditional language instruction and real-world communicative needs.

Digital learning platforms, mobile applications, and AI-supported tools constitute another dimension of theoretical significance. Guz (2024) emphasizes that these technologies provide opportunities for individualized learning, adaptive feedback, and autonomous practice, which complement traditional instructional methods. Such tools enable learners to engage with professional terminology, procedural language, and communication exercises at their own pace, promoting both motivation and cognitive engagement. AI-driven analytics can track learner performance, identify gaps in comprehension, and suggest targeted exercises, thereby theoretically optimizing the learning trajectory. Digital platforms also facilitate continuous learning outside the classroom, creating opportunities for rehearsal and reinforcement of communicative skills essential for professional maritime contexts.

A critical theoretical insight from the literature is the potential for synergistic integration of multiple technologies. While simulators and VR environments provide immersive, experiential learning, corpus-informed instruction ensures linguistic accuracy and relevance, and AI/digital platforms support personalized, adaptive learning. The combination of these approaches theoretically maximizes exposure to realistic communicative scenarios, strengthens procedural fluency, and fosters the transfer of classroom-acquired skills to operational contexts. However, the literature also highlights unresolved challenges, such as curriculum alignment, instructor preparedness, evaluation of learning outcomes in technology-rich environments, and long-term retention of communicative competence. These issues suggest that, while the theoretical potential of these innovations is substantial, their successful implementation depends on careful design, standardization, and integration into maritime educational programs.

Furthermore, the analysis reveals that professional communicative competence is not merely a linguistic skill but a multidimensional construct involving cognitive, social, and situational components. Immersive simulations, when combined with corpus-informed tasks and adaptive digital platforms, can theoretically support the development of these dimensions simultaneously. Cadets not only acquire the linguistic structures necessary for shipboard communication but also develop decision-making strategies, situational awareness, and intercultural communication skills.

This holistic perspective underscores the necessity of integrating theoretical insights from applied linguistics, educational technology, and maritime training standards to create comprehensive, evidence-based pedagogical frameworks.

In summary, the theoretical synthesis of the literature indicates that the coordinated application of simulators, VR/AI tools, digital platforms, and corpus-informed instruction provides a robust basis for enhancing Maritime English learning. This integrated approach allows cadets to engage with realistic communication scenarios, acquire professional terminology, practice procedural language, and develop critical cognitive and social competencies. The study's findings contribute to a deeper understanding of the mechanisms through which technology can support the development of professional communicative competence, highlight existing gaps in implementation and research, and provide a foundation for future empirical validation and practical application in maritime education.

Moreover, the literature emphasizes the importance of adaptive and personalized learning pathways within Maritime English instruction. By integrating AI-assisted tools and digital platforms, educators can monitor cadets' individual performance, identify specific linguistic weaknesses, and provide targeted exercises tailored to the learners' needs. This theoretically enhances not only the acquisition of vocabulary and standardized phrases but also the ability to respond appropriately in varied operational contexts. For instance, cadets may receive scenario-specific prompts that simulate emergencies, bridge operations, or intercultural communication, thereby fostering decision-making skills alongside linguistic competence. Such adaptive mechanisms align with modern pedagogical theories, which highlight the interplay between learner autonomy, feedback-driven improvement, and cognitive engagement.

The research also underlines the multidimensional nature of professional communicative competence, which extends beyond mere linguistic proficiency. Competence in this context involves cognitive, social, and situational components, encompassing the understanding of procedural protocols, cross-cultural communication, and situational awareness. Simulation-based environments and VR/AR technologies contribute to these dimensions by immersing cadets in scenarios that require active problem-solving, teamwork, and real-time application of communication protocols. According to Kim et al. (2021) and Tovstokoryi & Popova (2021), this immersive exposure can strengthen cognitive schemas associated with maritime operations, enabling learners to internalize procedural language patterns and develop anticipatory skills critical for effective shipboard interaction.

Another key aspect highlighted in the literature is the integration of corpus-informed instruction. Corpus analysis allows instructors to identify frequently used lexical bundles, specialized terminologies, and pragmatic patterns relevant to operational contexts. By aligning curriculum content with authentic linguistic usage, cadets are exposed to language that reflects actual industry practices rather than purely theoretical examples. This approach ensures that learning is relevant, targeted, and directly applicable to the tasks that future marine officers will encounter. It also supports the development of situated competence, enabling learners to employ language appropriately across different scenarios and cultural contexts.

Despite these advances, the literature consistently points to challenges in methodological integration. The successful implementation of innovative technologies requires careful alignment with curriculum objectives, instructor training, and standardized assessment protocols. Research by Guz (2024) emphasizes that without proper pedagogical scaffolding, the potential of VR, AI, and digital platforms may not be fully realized. Additionally, some studies note the lack of longitudinal research on the retention of communicative competence over time, highlighting a critical gap for future empirical investigation. Addressing these challenges theoretically involves designing frameworks that combine immersive practice, data-driven personalization, and evidence-based evaluation, thus creating a comprehensive ecosystem for Maritime English learning.

Finally, the theoretical synthesis suggests that a holistic and interdisciplinary approach is necessary for maximizing learning outcomes. Integrating insights from applied linguistics, educational technology, cognitive psychology, and maritime operational standards can inform the development

of robust instructional frameworks. Such frameworks not only enhance linguistic proficiency but also cultivate problem-solving abilities, intercultural awareness, and adaptive decision-making. By fostering these interconnected competencies, technology-enhanced Maritime English instruction equips cadets with the skills necessary for professional performance, operational safety, and effective communication in increasingly complex maritime environments. The integration of simulation, VR/AR, AI-assisted tools, and corpus-informed content thus represents a forward-looking strategy for maritime education, bridging the gap between theoretical knowledge and practical applicability while laying a foundation for future research and refinement of instructional practices.

The theoretical analysis conducted in this study demonstrates that innovative educational technologies, including simulators, virtual reality, AI-supported tools, and digital learning platforms, play a crucial role in enhancing professional communicative competence in Maritime English instruction. Simulator-based and VR-enhanced environments provide immersive, realistic scenarios that allow cadets to practice Standard Marine Communication Phrases, emergency protocols, and collaborative decision-making, supporting experiential learning and improving accuracy, clarity, and situational appropriateness. Corpus-informed instruction and needs-analysis approaches ensure that learning materials are aligned with authentic operational language demands and IMO standards, enhancing the functional relevance of language acquisition. Digital and AI-driven platforms offer opportunities for individualized, adaptive learning, reinforcing cognitive engagement, motivation, and autonomous practice.

The synthesis of these findings indicates that a coordinated integration of multiple technologies provides the most comprehensive theoretical framework for developing professional communicative competence. Cadets can simultaneously develop linguistic, cognitive, and social skills necessary for effective shipboard communication in multicultural environments. However, the study also identifies unresolved challenges, including curriculum alignment, instructor preparedness, assessment of learning outcomes in technology-rich environments, and long-term retention of skills.

Future research in this area should focus on empirical validation of the theoretical insights presented. Longitudinal studies are needed to assess the sustained impact of technology-enhanced instruction on cadets' performance in operational settings. Comparative analyses of different technological approaches, as well as investigations into optimal combinations of simulators, VR, AI, and digital platforms, would provide practical guidance for curriculum design. Further studies should also explore standardized assessment methods and instructor training programs to ensure effective implementation of innovative technologies. Finally, interdisciplinary research combining applied linguistics, educational technology, and maritime education standards will be essential for developing evidence-based, scalable pedagogical frameworks capable of preparing future deck officers for the evolving demands of the international maritime industry.

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Tsyhanenko O. A. Innovative technologies in Maritime English instruction: a theoretical analysis of the development of professional communicative competence of future marine officers

The article presents a theoretical analysis of the potential of innovative educational technologies in developing the professional communicative competence of future marine officers within the framework of Maritime English training. Based on a review of contemporary scholarly works, the study examines the possibilities and specific features of using simulators, virtual reality, digital learning platforms, and AI-driven tools that enable the modelling of real shipboard situations, improvement of proficiency in Standard Marine Communication Phrases, and enhancement of professional interaction skills within multicultural crews. It is demonstrated that corpus analysis and language-needs identification methods allow for the optimization of instructional content in accordance with international standards and communicative protocols. A synthesis of research findings indicates that the highest effectiveness can be achieved through an integrated combination of simulation-based, digital, and analytical technologies, which jointly contribute to the development of linguistic, cognitive, and social components of professional competence. At the same time, the study outlines several unresolved issues related to methodological integration of technologies, teacher training, and the standardization of learning outcome assessment. Future research perspectives include conducting empirical and comparative studies aimed at identifying optimal models for implementing innovative technologies in the training of maritime professionals.

Key words: innovative technologies, Maritime English, professional communicative competence, training of future deck officers, theoretical analysis.

Циганенко О. А. Інноваційні технології в навчанні морської англійської мови: теоретичний аналіз розвитку професійної комунікативної компетенції майбутніх судноводіїв

У статті здійснено теоретичний аналіз можливостей інноваційних освітніх технологій у формуванні професійної комунікативної компетентності майбутніх морських офіцерів у процесі навчання морській англійській мові. На основі вивчення сучасних наукових праць розглядаються потенціал та специфіка використання тренажерів, віртуальної реальності, цифрових платформ та ІТ-інструментів штучного інтелекту, що забезпечують моделювання реальних суднових ситуацій, удосконалення володіння стандартними фразами морської комунікації та розвиток навичок професійної взаємодії в умовах багатокультурного екіпажу. Показано, що корпусний аналіз і методи визначення мовних потреб дають змогу оптимізувати зміст навчання відповідно до вимог міжнародних стандартів і комунікативних протоколів. Узагальнення результатів наукових джерел засвідчує, що найвищу ефективність може забезпечити комплексне поєднання симуляційних, цифрових та аналітичних технологій, яке сприяє одночасному розвитку мовних, когнітивних і соціальних компонентів професійної компетентності. Водночас виявлено низку нерозв'язаних питань, пов'язаних із методичною інтеграцією технологій, підготовкою викладачів та стандартизацією оцінювання результатів навчання. Перспективи подальших досліджень вбачаються в проведенні емпіричних та порівняльних робіт, спрямованих на визначення оптимальних моделей упровадження інновацій у підготовку морських фахівців.

Ключові слова: інноваційні технології, морська англійська мова, професійна комунікативна компетентність, підготовка майбутніх судноводіїв, теоретичний аналіз.

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Дата першого надходження статті до видання: 30.12.2025
Дата прийняття статті до друку після рецензування: 27.02.2026
Дата публікації (оприлюднення) статті: 30.03.2026