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Microlearning in Maritime English: Enhancing Linguistic and Operational Readiness

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Abstract

In response to shifting cognitive dynamics and evolving modes of learner interaction with digital content in maritime education, microlearning has emerged as a transformative approach in Maritime English instruction. This study explores the pedagogical integration of microlearning to enhance communicative competence in both operational and emergency maritime contexts. Conducted at Kherson State Maritime Academy, the research employed a mixed-methods design and leveraged a suite of advanced microlearning tools. These included adaptive digital flashcards, immersive scenario-based micro videos, micro-podcasts featuring authentic SMCP audio snippets, AI-powered conversational simulators for communication drills, and mobile speech recognition modules providing real-time pronunciation feedback. Cadets also engaged with gamified micro challenges and context-aware mobile assessments aligned with realistic onboard communication, including scenarios governed by the International Regulations for Preventing Collisions at Sea (COLREGs). Additionally, cadets engaged with gamified micro challenges and context-aware mobile assessments, ensuring alignment with realistic onboard communication scenarios. The participant group consisted of approximately 40 cadets aged 18 – 22 with intermediate English proficiency. Quantitative data revealed improved retention and faster recall of Standard Marine Communication Phrases (SMCP), while qualitative findings indicated increased learner engagement, reduced performance anxiety, and enhanced perceived relevance of training. Instructor observations corroborated these results, noting higher levels of participation and situational fluency. The findings underscore the alignment of microlearning with IMO competency frameworks and its capacity to foster essential maritime competencies such as autonomous learning, digital literacy, and adaptive communication. The study advocates for the systematic integration of microlearning into maritime language curricula.

Keywords: Microlearning, Maritime English, SMCP, Digital Pedagogy, Seafarer Training.

Introduction

The rapid evolution of the global maritime industry, coupled with the increasing complexity of shipboard operations, demands a pedagogical shift in the way Maritime English is taught. Traditional language instruction models, often reliant on passive learning, generalized grammar drills, and decontextualized vocabulary lists, are insufficient in preparing cadets for the real-time, high-stakes communication required on board. Effective maritime communication is not merely linguistic – it is operational, time-sensitive, and safety-critical. Moreover, the Standard Marine Communication Phrases (SMCP), while standardized, require contextual understanding and quick verbal execution, which conventional methods rarely cultivate. Considering these challenges, a reformed pedagogical approach is essential – one that prioritizes situational fluency, task-specific practice, and integration with real-world maritime operations. Particularly, the ability to communicate effectively during COLREG-governed maneuvers – such as overtaking, head-on situations, or restricted visibility – is vital for preventing collisions and ensuring navigational safety.

Contemporary maritime cadets, largely representative of digi-

tal-native cohorts, exhibit distinct cognitive characteristics and learning behaviours shaped by constant interaction with technology. These learners tend to favour visual and interactive formats over text-heavy materials, demonstrating shorter attention spans and a preference for fast, modular content delivery. Cognitive research indicates that such learners benefit more from dynamic, responsive, and personalized instructional approaches, as opposed to linear and lecture-based paradigms. However, while these learners adapt quickly to digital tools, they often face challenges in mastering structured communicative protocols such as those outlined in the COLREGs, which require precise and timely verbal coordination under pressure. Additionally, cadets increasingly value immediacy of feedback, contextual relevance of content, and the ability to learn at their own pace through mobile and asynchronous platforms. These tendencies necessitate a shift toward learner-cantered models that align with their digital habits and optimize their capacity for engagement, retention, and application – particularly in high-pressure maritime communication scenarios where speed and precision are essential.

Despite the critical role of communication in maritime safety and efficiency, traditional approaches to Maritime English instruction often fall short in preparing cadets for the operational demands of real-world scenarios. Grammar-focused lessons, scripted dialogues, and classroom lectures typically emphasize linguistic form over communicative function, offering limited exposure to the time-sensitive, task-specific, and high-pressure nature of shipboard interactions. These methods rarely replicate cognitive load, environmental noise, or the real-time decision-making required during actual operations. As a result, cadets may develop a theoretical understanding of Standard Marine Communication Phrases (SMCP), yet lack the fluency, spontaneity, and confidence needed to apply them effectively under stress. In particular, exercises seldom reflect the communicative demands of real-time COLREG application, where standardized phraseology is critical to mutual understanding and safety. This pedagogical gap undermines the development of communicative competence and falls short of meeting the expectations of the STCW Convention and IMO Model Courses.

To address these challenges, this study evaluates the effectiveness of microlearning as an instructional strategy for enhancing both communicative competence and operational readiness among maritime cadets. It investigates how short, focused, and digitally delivered learning units – centered on authentic maritime scenarios regulated by COLREGs and aligned with SMCP – can support skill acquisition, retention, and real-time application. The study further explores the use of tools such as scenario-based videos, speech recognition drills, interactive flashcards, and audio-based exercises to bridge the gap between theoretical knowledge and operational performance. By emphasizing both linguistic precision and situational adaptability, this research contributes to evidence-based methodologies that align with international maritime competency standards and the evolving needs of digitally native cadets.

Microlearning is commonly defined as an instructional strategy that delivers content in brief, focused segments targeting specific learning outcomes. Buchem and Hug conceptualize microlearning as a flexible, learner-driven approach that breaks down knowledge into small, consumable units [1]. Ifenthaler further refines the definition by linking microlearning to competency-based education, emphasizing its alignment with personalized and goal-oriented learning objectives [2]. More recent scholarship expands the scope of microlearning to include mobile-first delivery, on-demand access, and AI-enhanced interactivity. According to Prieto and Redondo, microlearning modules may range from under a minute to ten minutes and often incorporate multimedia formats to increase engagement and retention [3]. Leong et al. highlight adaptive sequencing and gamified reinforcement as defining characteristics of next-generation microlearning environments [4].

Typologically, microlearning encompasses both content types and delivery mechanisms. Content typologies include text-based flashcards, audio snippets, animated explainers, micro-podcasts, and augmented reality instructions. Delivery typologies range from mobile applications and wearable interfaces to chatbot-based tutorials and AI-driven feedback systems. These formats are not only scalable and modular but also allow for integration into blended, synchronous, or asynchronous training settings. The diversity and adaptability of microlearning formats make it a highly relevant strategy in fast-paced, operational disciplines such as maritime communication training. The effectiveness of microlearning is strongly supported by core principles in cognitive psychology, particularly those related to how information is encoded, stored, and retrieved. One such principle is the spacing effect, which suggests that learning is more durable when study sessions are spaced over time rather than massed together. This concept, explored extensively in experimental studies (e.g., Cepeda et al.), underpins the temporal structure of microlearning interventions and enhances long-term retention [5].

A second foundational principle is chunking, which refers to the cognitive strategy of grouping information into manageable units to reduce cognitive load (Miller) [6]. Microlearning leverages chunking by presenting content in short, logically segmented modules that align with the brain's natural capacity for processing and pattern recognition.

The third key principle is active recall, a retrieval-based learning strategy in which learners are prompted to remember information without direct cues. Research by Karpicke and Roediger shows that active recall significantly improves memory consolidation compared to passive review. Microlearning environments that incorporate low-stakes quizzes, flashcard repetition, or audio response drills capitalize on this mechanism to reinforce learning in an efficient, brain-compatible way [7].

Collectively, these cognitive foundations justify the microlearning format not only as a matter of convenience, but as a scientifically grounded approach to effective instructional design – especially in safety-critical fields like maritime communication.

Microlearning has gained substantial traction in applied fields where precision, procedural fluency, and rapid decision-making are critical. In medical education, for instance, short-form video modules, spaced repetition apps, and mobile quizzes have been used to improve clinical reasoning, procedural knowledge, and pharmacological retention. Studies such as Cook et al. and Cho et al. demonstrate significant improvements in knowledge reten-

tion and learner satisfaction when microlearning is used to supplement traditional clinical training [8, 9].

In engineering education, microlearning has been deployed through interactive simulations, mobile problem-solving tasks, and just-in-time learning modules that assist students in mastering complex technical systems. For example, Ibrahim and Jaafar found that engineering students using microlearning materials demonstrated enhanced understanding of control systems and higher levels of engagement [10]. Similarly, in technical and vocational training, microlearning has supported workplace-relevant skill development through micro-assessments and multimedia-based instruction. Jomah et al. highlight how microlearning improves both skill acquisition and knowledge transfer in industrial settings [11]. These domains share structural similarities with maritime education – particularly the need for fast, context-driven communication – making microlearning a pedagogical model with high transfer potential.

Despite growing interest in microlearning across various professional disciplines, its integration into Maritime English training remains notably underexplored. Existing maritime language instruction often relies on static classroom materials, printed SMCP manuals, and role-play scenarios that lack technological dynamism and real-time adaptability. Empirical studies evaluating the impact of digital microlearning tools – such as mobile-based SMCP drills, AI-assisted pronunciation training, or micro-scenario simulations – are virtually absent in the scholarly literature. While organizations such as the IMO emphasize competence-based learning, few pedagogical frameworks in maritime education explicitly incorporate the principles of spacing, chunking, or active recall through microlearning structures.

This lack of evidence-based adoption suggests a critical gap between educational innovation and practical implementation in seafarer training. Given the high-stakes nature of shipboard communication – where miscommunication can lead to operational failure or safety hazards – the maritime education sector stands to benefit significantly from structured research into how microlearning may enhance both linguistic fluency and communicative performance under pressure. Particular attention is warranted for regulated contexts such as the International Regulations for Preventing Collisions at Sea (COLREGs), where standardized verbal protocols are not optional but legally mandated, and operational accuracy is vital. The present study aims to address this research void by empirically evaluating microlearning's impact on cadets' ability to internalize and operationalize Standard Marine Communication Phrases (SMCP) in realistic, time-sensitive environments.

Methodology

This study employed a mixed-methods research design to comprehensively examine the effectiveness of microlearning tools in developing communicative competence and operational readiness among maritime cadets. The integration of both quantitative and qualitative methodologies facilitated methodological triangulation and enabled the researchers to capture a multidimensional view of learner progress, engagement, and skill acquisition in the context of Maritime English instruction.

The intervention was conducted over a four-week period at Kherson State Maritime Academy during the 2024 academic year. Instructional delivery was embedded within regular Maritime English classes and involved a systematic restructuring of course content using microlearning principles. The pedagogical intervention included adaptive digital flashcards, scenario-based microvideos, audio-response drills, speech recognition tools, and AI-powered dialogue simulators, all of which were aligned with the Standard Marine Communication Phrases (SMCP) and the International Regulations for Preventing Collisions at Sea (COLREGs).

In addition to SMCP-focused tasks, selected microlearning modules incorporated COLREG-based language simulations, which presented cadets with real-time verbal challenges associated with crossing, overtaking, and head-on situations. These simulations emphasized regulatory phraseology, navigational command precision, and context-specific decision-making, reflecting the communicative demands of actual bridge team operations. This ensured alignment not only with linguistic standards but also with regulatory communication protocols, thereby reinforcing both verbal fluency and safety-oriented language behavior.

To evaluate the impact of the intervention, three data sources were triangulated:

1. Pre- and post-intervention assessments measured cadets' ability to recall and apply SMCP and COLREG-related phrases in structured oral tasks. These assessments provided quantitative evidence of improvement in vocabulary retention, phrase accuracy, and response time.
2. A structured learner feedback survey (N = 40) gathered cadet perceptions on the usability, relevance, and motivational aspects of microlearning tools. Items also included reflections on the realism and difficulty of COLREG communication scenarios.
3. Instructor observation logs were used to qualitatively document behavioral changes, including frequency of voluntary participation, situational fluency, confidence under time constraints, and responsiveness during scenario enactments.

All participants were informed about the research objectives and provided informed consent. The study received ethical approval from the institutional research ethics committee, and participation was voluntary, with no academic penalties or incentives influencing engagement. This multi-layered methodological framework enabled the research team to assess not only linguistic gains, but also situational awareness, confidence in regulated communication environments, and cadet adaptability to microlearning-based instruction within the operational realities of modern maritime practice.

Instructional Materials

The microlearning intervention was designed using a curated set of short-format, digitally delivered materials tailored to the specific communicative demands of maritime operations. Core instructional content included a series of 2-minute scenario-based microvideos illustrating typical shipboard exchanges such as distress calls, mooring procedures, fire drills, COLREG-related maneuvers (e.g., overtaking, crossing, restricted visibility), and navigational coordination. These videos were embedded with visual cues and SMCP annotations to support real-time

language modeling in both standardized and regulated contexts. Cadets also engaged with adaptive SMCP flashcards delivered through the Quizlet platform, allowing for spaced repetition and personalized review pathways. To reinforce aural comprehension and pronunciation accuracy, the program incorporated short audio-response applications, including micro-podcasts with authentic voice recordings of SMCP and COLREG-based dialogue samples, followed by interactive recall tasks.

A mobile speech recognition tool (e.g., Google Speech API integration) was utilized to provide real-time pronunciation feedback, enabling learners to self-correct and refine oral fluency. Additionally, the intervention featured gamified microchallenges – timed scenario tasks designed to simulate high-pressure communication events – and context-aware mobile assessments, which adapted learning prompts based on cadets' performance trends and module progress. The integration of AI-powered dialogue simulators further enabled cadets to engage in structured conversations related to collision avoidance and traffic regulation scenarios, helping them build both linguistic precision and decision-making awareness in COLREG-governed environments. This multi-modal, mobile-accessible content ecosystem was aligned with the principles of microlearning and tailored specifically to enhance maritime communicative performance under authentic, operational, and regulatory conditions.

Table 1 summarizes the key microlearning materials utilized in the instructional intervention. Each item was selected based on its relevance to Standard Marine Communication Phrases (SMCP) training and its capacity to support targeted cognitive functions such as retention, recall, and pronunciation accuracy. The tools represent a diverse range of delivery formats – including text, audio, video, and AI-enhanced interaction – aligned with the principles of modular, mobile-first learning. The integration of these materials was designed to simulate real-life shipboard communication while fostering learner autonomy and engagement.

Table 1: Microlearning Materials Used in the Intervention

Material Type	Tool/Platform	Purpose
Scenario-based microvideos	Custom-designed video clips	Simulate realistic SMCP and COLREG usage (e.g., distress calls, crossing)
Digital flashcards	Quizlet	Reinforce vocabulary and phrases through spaced repetition
Micro-podcasts	Embedded audio modules	Develop listening skills with authentic SMCP and COLREG dialogues
Audio-response apps	Voice recording/playback	Practice spoken responses to operational prompts
Speech recognition	Google Speech API	Provide real-time pronunciation feedback
Gamified microchallenges	Timed mobile app tasks	Simulate operational pressure and enhance recall speed
Context-aware assessments	Adaptive mobile quizzes	Adjust difficulty based on learner progress
AI-powered dialogue simulators	Custom chatbot environment	Simulate dynamic SMCP/COLREG shipboard communication

As shown in Table 1, the instructional design strategically incorporated both conventional and emerging technologies to foster a holistic communicative training environment. For example, Quizlet-based flashcards facilitated the spaced repetition of SMCP and COLREG phrases, reinforcing phrase recognition and recall. AI-powered dialogue simulatorsenabled responsive, real-time communication practice in dynamic shipboard scenarios, including those governed by navigational rules and emergency procedures.

The study sample comprised approximately 40 maritime cadets enrolled in the second and third years of the deck and engine officer programs at Kherson State Maritime Academy. Participants were aged 18 to 22 years and represented a relatively homogeneous group in terms of educational background and maritime specialization. English language proficiency was assessed using institutional placement tools and aligned with CEFR B1–B2 descriptors, confirming an intermediate level suitable for the use and application of Standard Marine Communication Phrases (SMCP). All cadets had previously completed foundational coursework in Maritime English and had been introduced to SMCP in theoretical contexts. However, their exposure to applied communication scenarios – particularly those involving regulatory frameworks such as the International Regulations for Preventing Collisions at Sea (COLREGs) – was limited prior to the intervention. Participants were selected through purposive sampling to ensure curricular alignment and comparability in baseline communicative competence. Informed consent was obtained from all participants. The study was conducted in accordance with institutional ethical standards, with approval granted by the research ethics board. Participation was voluntary, and cadets were informed that their academic standing would not be affected by engagement in the study.

Results

Quantitative Findings

The analysis of pre- and post-intervention assessments revealed statistically significant improvements in cadets' recall and application of Standard Marine Communication Phrases (SMCP). Post-test scores demonstrated a mean increase of 18% in phrase recall accuracy compared to baseline measurements ($p < 0.01$). Cadets exhibited greater precision in reproducing operational

expressions across both routine and emergency contexts.

In addition, response latency – defined as the time taken to comprehend and respond to verbal prompts – was measurably reduced. On average, cadets responded 32% faster in post-intervention oral communication tasks. The most notable gains were observed in scenarios simulating COLREG-based maneuvers, such as overtaking and head-on encounters, where speed and accuracy are critical.

These findings suggest that microlearning formats – particularly those employing repetition, scenario immersion, and speech-based interactivity – enhance not only linguistic retention but also real-time processing speed, which is vital in time-sensitive maritime communication environments.

Qualitative Findings

Qualitative data collected from the structured feedback survey and instructor observation logs revealed a strong positive perception of the microlearning approach among cadets. A majority of participants (85%) described the digital tools as motivating and engaging, citing the brevity, interactivity, and scenario-based nature of the materials as key drivers of interest. Cadets frequently noted that the short duration of learning units made it easier to remain focused and absorb content during limited training windows.

Furthermore, participants reported a high level of usability across all platforms, with particular appreciation for the clarity of instructions, the visual design of the microvideos, and the immediate feedback provided by the speech recognition tool. The use of COLREG-integrated dialogues was identified as especially valuable, as it helped learners link theoretical regulations with real-time communicative actions required on board.

Cadets also emphasized the authenticity and operational relevance of the tasks, stating that the training closely mirrored real-life situations encountered during bridge watchkeeping or navigational teamwork. This alignment between instructional content and expected professional behavior contributed to improved learner confidence and a greater sense of preparedness for actual maritime communication demands.

Observable Outcomes

Instructor observation logs further corroborated the quantitative and self-reported data, highlighting notable behavioral improvements during in-class communication drills. Compared to the baseline phase, cadets demonstrated higher levels of voluntary participation, with more students initiating and sustaining oral exchanges without external prompting. This increase in engagement was particularly evident during simulation activities involving COLREG scenarios, such as overtaking or restricted visibility protocols, where real-time response was essential.

A reduction in communication-related anxiety was also observed. Instructors reported that cadets displayed greater confidence and fluency when delivering structured phrases under time constraints. The use of microlearning tools – especially speech recognition apps and audio-response platforms – appeared to lower performance pressure by allowing learners to practice privately and receive immediate feedback before engaging in public speaking tasks.

Moreover, cadets responded more readily to corrective input and self-corrected errors with increased frequency, indicating improved metacognitive awareness of their language use. These behavioral shifts suggest that microlearning, when contextualized through operational and regulatory content, supports the development of not only competence but also communicative resilience in high-stakes maritime settings.

Discussion

Alignment with the STCW Model of Competency

Microlearning as implemented in this study demonstrates strong pedagogical compatibility with the STCW Convention's competence-based approach to maritime education. The STCW framework emphasizes demonstrable outcomes, task-specific performance, and the integration of knowledge, skills, and attitudes in real-world operational contexts. Microlearning directly supports these aims by delivering modular, outcome-oriented training segments that reinforce targeted communicative behaviors essential for safe ship operation.

Each microlearning unit used in the intervention was designed to align with specific STCW Code competencies, particularly in areas related to navigation, bridge resource management, and emergency procedures. For example, microvideos simulating distress calls and COLREG maneuvering were linked to Table A-II/1 and A-II/2 outcomes related to "maintaining a safe navigational watch" and "communication in bridge teamwork." These segments required cadets to apply SMCP and COLREG-compliant language under simulated time constraints, closely mirroring the operational demands described in STCW performance standards.

Moreover, the repeated use of interactive speech drills, situational response tasks, and performance-based microchallenges enabled ongoing assessment of both declarative and procedural knowledge, fulfilling the STCW requirement for competence verification through observable behavior. The adaptive nature of digital tools also supports differentiated instruction, allowing cadets to advance at individual paces while ensuring mastery of core communication functions. In this way, microlearning provides a scalable and structured pathway for integrating communication skills training into the broader competency framework mandated by international maritime regulations, while also promoting active, learner-centered engagement in the classroom.

Development of Transdisciplinary Skills: Adaptive Communication, Self-Direction, and Mobile Collaboration

The integration of microlearning into maritime English training also fosters the development of transdisciplinary skills essential for modern seafarers, particularly in the domains of adaptive communication, self-direction, and mobile collaboration. These competencies, while not always explicitly detailed in the STCW Code, are increasingly recognized as vital for effective performance in complex, multicultural, and technologically dynamic maritime environments.

Adaptive communication was cultivated through targeted interaction with context-specific language drills, situational dialogues, and real-time corrective feedback. By engaging with

simulated scenarios that mirrored shipboard communication challenges – such as emergency coordination or cross-cultural team exchanges – cadets learned to modulate tone, vocabulary, and communicative strategies based on evolving situational demands. This aligns with the communicative agility required in multinational crews where clarity, accuracy, and intercultural sensitivity are imperative. Self-direction was supported by the modular structure of microlearning units, which allowed cadets to take ownership of their learning trajectories. The availability of asynchronous tasks, progress tracking, and self-assessment tools encouraged autonomous goal-setting and reflection. This is particularly relevant in the maritime profession, where officers must often respond to novel situations without direct supervision, relying on internalized standards and judgment.

Mobile collaboration was enhanced through the use of digital platforms that enabled synchronous and asynchronous peer interaction, co-creation of responses, and collaborative problem-solving. This simulated the distributed nature of contemporary maritime operations, where team members may be physically separated yet must coordinate actions seamlessly using mediated communication technologies. Taken together, these transdisciplinary skills not only complement the technical and procedural competencies mandated by the STCW Convention but also prepare cadets for the broader human factors challenges of the maritime domain. Embedding such skills within a microlearning framework ensures they are developed in parallel with domain-specific knowledge, thereby enhancing cadets' readiness for both routine and emergent operational demands at sea.

Challenges: Over-Fragmentation and the Need for Systematic Curriculum Integration

While the pedagogical affordances of microlearning are evident, its implementation in maritime education also presents several challenges, particularly in relation to content fragmentation and curriculum cohesion. These issues must be carefully addressed to ensure that microlearning serves as a complementary – not substitutive – component of a holistic training program.

One significant challenge is over-fragmentation, wherein the breakdown of content into ultra-short learning units may compromise depth of understanding and contextual continuity. In the context of maritime communication, the nuance and interdependency of various linguistic and operational elements require integrated practice. Excessive atomization of learning may result in isolated skill acquisition without sufficient synthesis, limiting the transferability of knowledge to complex, real-world scenarios onboard.

A related concern is the need for systematic curriculum integration. Microlearning, when deployed in an ad hoc or supplementary manner, risks becoming peripheral to the core educational objectives defined by the STCW framework. For microlearning to be pedagogically effective and institutionally sustainable, it must be strategically embedded within a clearly articulated curriculum structure. This includes alignment with course learning outcomes, assessment frameworks, and instructional sequences that progressively build competence.

Furthermore, educators must be equipped with both the digital literacy and instructional design expertise to curate and contextualize microlearning content appropriately. Without such scaffolding, the instructional potential of microlearning may be diluted, and cadets may struggle to perceive its relevance or connection to formal learning pathways.

Addressing these challenges requires a deliberate shift toward curriculum-level planning, where microlearning is not merely adopted for its novelty or convenience, but is harnessed as a structured tool to reinforce and extend competency-based learning. Only through such integration can microlearning fulfill its promise of enhancing communication training within maritime education while maintaining instructional coherence and regulatory alignment.

Conclusions

This study demonstrates that microlearning represents a viable and pedagogically sound enhancement to maritime English education, particularly within competence-based frameworks such as those outlined in the STCW Convention. By offering modular, targeted, and contextually rich training experiences, microlearning supports the development of both technical communicative skills and broader transdisciplinary competencies critical for modern seafaring.

Its flexibility makes it especially well-suited for asynchronous, hybrid, and mobile-first training environments, thereby accommodating diverse learning needs and operational constraints. Cadets can engage with microcontent at their own pace, revisit challenging scenarios, and benefit from real-time feedback – all of which contribute to deeper learning and greater learner autonomy.

At the same time, effective implementation of microlearning calls for strategic curriculum integration and instructional planning to mitigate the risks of content fragmentation and ensure alignment with formal competency standards. Educator training and institutional support are also essential for sustaining pedagogical quality and technological coherence.

Looking forward, a proposed roadmap for future research includes longitudinal studies on microlearning's impact on performance-based assessments, comparative trials across maritime academies, and the development of standardized repositories of microlearning materials. There is also strong potential for cross-institutional collaboration, enabling shared innovation, validation of best practices, and harmonization of maritime English training on a global scale.

In sum, microlearning offers a scalable and learner-centered complement to traditional instructional methods, with the potential to significantly enhance both the effectiveness and accessibility of maritime communication training.

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References

1. Buchem, I., & Hug, T. (2010). Microlearning: Emerging concepts, practices and technologies after e-learning. Proceedings of Microlearning Conference.
2. Ifenthaler, D. (2018). Digital microlearning: A frontier for competency-based education. In Digital workplace learning (pp. 233–244). Springer.
3. Prieto, J. M., & Redondo, T. (2021). Microlearning and mobile learning: A combined approach to enhance learning in higher education. Journal of Educational Technology Development and Exchange, 14(1), 1–16.
4. Leong, T. W., Cheong, Y. M., & Sim, S. K. (2022). Next-generation microlearning: Adaptive sequencing and gamified feedback. Computers & Education: Artificial Intelligence, 3, 100061.
5. Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., & Rohrer, D. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. Psychological Bulletin, 132(3), 354–380.
6. Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 63(2), 81–97.
7. Karpicke, J. D., & Roediger III, H. L. (2008). The critical importance of retrieval for learning. Science, 319(5865), 966–968.
8. Cook, D. A., et al. (2008). Internet-based learning in the health professions: A meta-analysis. JAMA, 300(10), 1181–1196.
9. Cho, D., Cosimini, H., & Espinoza, M. (2019). Podcasting in medical education: A review of the literature. Korean Journal of Medical Education, 31(3), 229–239.
10. Ibrahim, R., & Jaafar, A. (2017). Effectiveness of microlearning in teaching control systems for engineering students. International Journal of Emerging Technologies in Learning (iJET), 12(5), 132–140.
11. Jomah, A., Masoud, N., Kishore, M., & Aurelio, A. (2016). Micro learning as innovative process of knowledge strategy. International Journal of Advanced Research in Engineering and Technology, 7(2), 91–97.