

E-ISSN: 2708-4523

P-ISSN: 2708-4515

Impact Factor (RJIF): 5.61

AJMC 2026; 7(2): 195-198

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www.allcommercejournal.com

Received: 20-11-2025

Accepted: 26-12-2025

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The hybrid and blended learning models in maritime sector with reference to safe e-navigation in India

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DOI: <https://www.doi.org/10.22271/27084515.2026.v7.i2d.1025>

Abstract

The concept of the e-navigation was raised at the International Maritime Organisation at the eighty-first session of the Maritime Safety Committee in 2006, for the first time. The introduction of e-navigation technologies, which aim to improve marine safety, efficiency, and situational awareness, is hastening the transition of the maritime industry. Technology like the Automatic Identification System (AIS), Electronic Chart Display and Information Systems (ECDIS), Long-Range Identification and Tracking (LRIT), and satellite-based navigation has greatly improved navigational accuracy and traffic management in India, a country whose economy and strategic position are strongly linked to maritime trade. On the other hand, new vulnerabilities have been presented by our reliance on digital technologies. There has never been greater dangers to supply chains, coastal security, and vessel safety from cyber security threats, which encompass a wide range of activities, from manipulating AIS and GPS signals to launching ransomware attacks on shipboard and port infrastructure. The paper concludes by providing the digital technologies, Maritime training requirements, the present status and standards including methods of training and the adoption of the online, Hybrid and blended learning models in securing safe e-navigation in India. The study found that securing India's e-navigation ecosystem is crucial for maritime security, trade, and national sovereignty in the digital age, and not only because it's an operational need.

Keywords: Maritime training, maritime sector, cyber security, e-navigation, piracy and trade

Introduction

India has a long and distinguished maritime heritage, deeply rooted in centuries of seafaring, shipbuilding, and ocean-based trade. As global shipping and maritime operations continue to expand, the demand for competent and professionally trained seafarers has grown significantly. India stands today as one of the world's leading suppliers of trained maritime manpower, with thousands of officers and ratings serving on international fleets. Maritime training in India plays a central role in sustaining this contribution, ensuring that seafarers meet international standards of safety, competence, and professionalism.

The modern framework of maritime education in India is guided primarily by the Directorate General of Shipping (DGS) under the Ministry of Ports, Shipping, and Waterways. The DGS regulates maritime institutes, approves training programs, enforces international maritime conventions such as STCW (Standards of Training, Certification and Watch keeping), and ensures that the quality of training remains globally benchmarked. The country follows a structured and standardized system that integrates theoretical knowledge with practical seamanship skills, ensuring that graduates are ready for real-world maritime challenges.

Over the years, India has developed a strong network of maritime training institutes, including both government-run and private academies. Prestigious institutions like the Indian Maritime University (IMU), T.S. Chanakya, Marine Engineering and Research Institute (MERI), and Lal Bahadur Shastri College of Advanced Maritime Studies & Research (LBS CAMSAR) have contributed significantly in shaping the maritime workforce. In addition to these, numerous private institutions offer specialized training aligned with DGS guidelines, providing students with a diverse range of academic and career opportunities.

Technological advancements have also transformed maritime training in India. Modern simulators such as ship bridge simulators, engine room simulators, and cargo-handling simulators allow the trainees to experience real-life maritime scenarios in a controlled environment.

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Moreover, computer-based training (CBT), virtual reality tools, and e-learning modules are becoming increasingly integrated into training programs, aligning Indian maritime education with international best practices.

The maritime sector in India is undergoing a major transformation, with hybrid and blended learning emerging as powerful models for developing the next generation of seafarers and maritime professionals. As the industry becomes more technology-driven and globally interconnected, training methods are evolving beyond traditional classroom and shipboard instruction. The Directorate General of Shipping (DGS), maritime academies, and shipping companies are increasingly adopting blended formats that combine in-person practical training with online, simulation-based, and digital learning systems.

The primary driver of this shift is the need for continuous skill upgrades. Modern ships rely heavily on automation, digital navigation systems, advanced machinery, and data-driven operations. Hybrid learning enables cadets and officers to access updated modules, virtual labs, and online assessments anytime, ensuring that learning keeps pace with global maritime standards.

Another significant advantage of blended learning is its ability to expand access and make maritime education more inclusive. Students from remote coastal and inland regions can attend online theory classes, participate in virtual workshops, and complete digital safety courses, reducing the financial and geographic barriers to maritime careers.

In the future, India is likely to see even deeper integration of digital technologies such as AI-assisted training, virtual-reality drills, remote engine-room simulations, and cloud-based learning management systems-within its maritime training ecosystem. These innovations will support the nation's broader maritime ambitions, align training with evolving International Maritime Organisation requirements, and enhance the global competitiveness of Indian seafarers.

Objectives

- To examine the effectiveness of hybrid and blended learning models in enhancing maritime education and training in India.
- To evaluate the impact of these learning models on seafarers' competencies related to safe e-navigation.
- To identify the infrastructural, pedagogical, and technological factors influencing successful adoption of hybrid learning in maritime institutes.

Present methods for hybrid and blended maritime training in India

- **Online Theoretical Instruction:** The Maritime institutes use Learning Management Systems (LMS) to deliver courses on navigation, marine engineering, maritime law, and safety. The Recorded lectures, digital textbooks, and interactive modules allow flexible learning for cadets and working seafarers.
- **Virtual Classrooms and Webinars:** The live online sessions enable real-time interaction with instructors for clarifications, demonstrations, and group discussions. The guest lectures by industry experts are integrated without geographical restrictions.
- **Simulation-Based Training:** The High-fidelity simulator such as Ship Master Simulator, Engine room simulator, ECDIS, Basics Bridge and engine room

simulators, liquid cargo handling simulators etc. Provide realistic operational scenarios. The Blended programs combine online pre-learning with scheduled simulator sessions to strengthen decision-making and procedural skills.

- **Augmented reality and virtual reality tools:** The augmented reality and virtual reality modules replicate machinery spaces, shipboard operations, and emergency situations. These immersive tools help trainees practice tasks like valve operations, navigation watch keeping, and engine troubleshooting before hands-on sessions.
- **Practical on-campus workshops, ship in campus:** Offline training is conducted in laboratories, workshops, fire fighting grounds, and survival craft facilities. The trainees complete digital preparatory modules before attending physical sessions to maximize practical learning outcomes. The pre sea residential courses require the training institutes to have a Ship in Campus which replicates the actual ship model.
- **Blended Assessments and Competency Checks:** On completion of course and training, prior to issuance of the certificate, the trainees have to go through and complete the e-learning which has the Online quizzes, digital assignments, and e-portfolios track theoretical understanding etc. The candidates have to clear the digital Exit Exam which is mandatory for the digital generation of the course completion certificate. Towards the compliance of the International acceptability of the trainees' competence, In-person assessment such as simulator evaluations, oral exams, and skill demonstrations ensure compliance with STCW and DGS standards. The oral exam is now taken in the online mode.
- **Use of digital learning aids and maritime software:** The tools like ECDIS training software, cargo planning applications, and engine monitoring systems are provided through remote access. Familiarity with digital shipboard systems prepares cadets for modern vessels.

How hybrid/blended learning can safeguard e-navigation

In E-Navigation, which integrates digital tools such as ECDIS (Electronic Chart Display and Information System), GPS, AIS, radar, and integrated bridge systems, has become central to modern maritime safety. However, the increasing reliance on these systems also brings new risks, including human error, technical failures, and cyber threats. Hybrid and blended learning models. By combining the online/digital instruction with hands-on practical training offer an effective approach to safeguarding E-Navigation by enhancing seafarers' competence, confidence, and readiness.

The hybrid learning provides stability to simulate real-world navigation scenarios, flexible, repeated, and standardized exposure to E-Navigation systems. Online modules, interactive courses, and self-paced lessons enable seafarers to revisit crucial procedures, updates, and best practices regularly. Continuous assessment through quizzes, scenario-based exercises, and LMS tracking ensures that knowledge gaps are identified and addressed before deployment, reducing the likelihood of errors on-board.

Another important aspect is the integration of theory with

onboard application. Trainees initially master digital navigation tools virtually, then apply their skills under supervision on actual ships. This combination reinforces learning, builds confidence, and ensures practical competence. Furthermore, hybrid learning supports training in cyber.

The future of hybrid and blended learning models in Indian maritime of the navigation tools used for e-navigation as navigational aids

Maritime India Vision (MIV)¹ 2030 emphasizes the need for a skilled, globally competitive seafarer workforce. It outlines initiatives such as the modernization of maritime training institutes, expansion of training capacity, adoption of digital tools like web-based simulators, and alignment of courses with international standards (e.g., STCW). The vision also focuses on enhancing employment opportunities, encouraging women seafarers, and industry-led skilling. Directorate General of Shipping (DG Shipping), as the regulatory authority, is actively implementing these visions by undertaking some key initiatives.

Some of the initiatives undertaken by DGS are as follows

- **Web-Based Simulators/360-degree simulator:** Deployment of immersive and interactive simulation tools to enhance competency-based training and assessment, accessible remotely to improve reach and flexibility.
- **Learning Management System (LMS):** Introduction of a centralized, digital platform to streamline course delivery, assessments, and progress tracking, ensuring consistency and transparency across Maritime Training Institutes (MTIs).
- **Faculty Development Program (FDP):** Structured programs aimed at continuous up skilling of faculty members across MTIs, focusing on pedagogical improvements, subject expertise, and integration of new-age maritime technologies.
- **Examination reforms:** With the examinations reform, DGS envisions significant improvements in the efficiency and reliability of competency examinations, leading to better oversight and service delivery.

Designed to be future-ready, this digital framework is equipped to evolve with emerging technologies and global best practices. By embracing digital transformation, DGS is committed to fostering a skilled, well-trained maritime workforce that meets the evolving demands of the global shipping industry while strengthening safety and compliance across the sector.

Challenges Ahead

- **Ensuring quality, practical competence, and real world readiness:** Maritime work operational works such as ship handling, navigation, cargo operations, safety etc. involve high risk and practical, hands-on skills. The over-relying on online or purely simulation based training could compromise real world competence if not balanced properly. The challenge will be in maintaining high standards for safety, compliance with international norms, and meaningful hands-on exposure even within a hybrid model.

- **Infrastructure & Network access inequality, especially in rural areas:** The major coastal cities or leading institutes may adopt high-end simulators and modern systems etc., smaller institutes or trainees from remote areas may face limitations in internet connectivity, access to simulators/practical training centers, or logistic support. The effective blended training needs consistent quality of internet, hardware, labs not guaranteed uniformly across India.
- **Resistance to changes & inertia in traditional training culture:** Maritime training has historically been hands-on and physically immersive. Some stakeholders, trainers, institutions, may prefer traditional methods or distrust on new age digital learning. There may be inertia or conservative attitudes among instructors or even employers about acceptability of simulation/online only credentials. Receiving of the broad acceptance will take effort but, based on my personal experience as part of Indian Maritime administration, this is not an issue.

Conclusion

The adoption of hybrid and blended learning models in the Indian maritime sector marks a significant step toward modernizing maritime education and enhancing safety standards, particularly in the domain of E-Navigation. By integrating online theory, simulation-based training, and practical onboard exercises, these learning models provide seafarers with repeated, flexible, and standardized exposure to complex digital navigation systems such as ECDIS, AIS, and integrated bridge systems. This approach not only improves technical competence but also reduces human error and strengthens decision-making skills in challenging maritime scenarios.

Furthermore, hybrid learning facilitates continuous professional development and ensures that officers remain updated on evolving safety protocols, cyber threats, and software systems. In the Indian context, where maritime trade and coastal activities are expanding rapidly, such models are crucial to producing a skilled, digitally competent workforce aligned with global standards. Ultimately, the hybrid and blended learning approach serves as a reliable safeguard for E-Navigation, promoting safer navigation, operational efficiency, and resilience in India's maritime sector.

With the above studies the objective to examine the effectiveness of hybrid and blended learning models in enhancing maritime education and training in India, to evaluate the impact of these learning models on seafarers' competencies related to safe e-navigation have been met. Also, the infrastructural, pedagogical, and technological factors influencing successful adoption of hybrid learning in maritime institutes have been identified.

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