

# Research on Generative AI-Empowered Training Model for Shipping Information Professionals

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**Abstract:** The rapid advancement of the digital economy and smart shipping has precipitated a growing demand for interdisciplinary professionals who possess both information technology expertise and maritime business literacy. However, the current vocational education system exhibits a misalignment with industrial needs, particularly in curriculum content, pedagogical models, and faculty competency. The emergence of Generative Artificial Intelligence (GenAI) provides a novel avenue for the intelligent transformation of vocational education, enabling personalized learning, dynamic curriculum generation, and multi-modal simulation. Grounded in the specific requirements of the smart shipping industry, this study leverages big data technology and maritime information scenarios to systematically construct a GenAI-empowered training model for shipping information professionals. This framework aims to resolve existing educational disconnects and enhance the quality of talent cultivation in the maritime sector.

**Keywords:** Generative Artificial Intelligence, Smart Shipping, Information Technology, Talent Training, Project-based Teaching, Industry-Education Integration.

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## 1. Introduction

The rapid evolution of digital technologies has profoundly reshaped global industrial structures, accelerating the transformation toward automation and intelligence across key sectors [1]. As a strategic pillar of national economic security and global trade, the shipping industry is at the forefront of this transformation. With the advancement of big data, artificial intelligence, cloud computing, and the Internet of Things, maritime governance, vessel operations, port logistics, and waterway management are becoming increasingly data-driven and intelligent. Smart shipping has emerged as a crucial direction for industrial upgrading, highlighting the urgent need for professionals capable of leveraging digital technologies to support maritime operations [2-3]. In this context, information-related specialties at vocational colleges must respond to major national strategies such as Digital China, Transportation Power, and Maritime Power, and actively reform talent training systems to align with the evolving demands of the smart shipping ecosystem.

Despite the strong momentum of industry development, vocational education still faces structural constraints in curriculum content, instructional methodology, and faculty competency. Traditional teaching materials often lag behind technological advancements; classroom-centered delivery models fall short of supporting differentiated learning needs; practical scenarios are limited and insufficiently aligned with real-world maritime applications; and faculty members often lack sustained exposure to industry practices, making it difficult to integrate cutting-edge knowledge into teaching. These limitations hinder the cultivation of high-quality, application-oriented professionals capable of engaging in smart shipping tasks such as data acquisition, analysis, visualization, and intelligent decision-making. As a result, the disconnection between the education chain and the industrial chain remains a prominent challenge [4]. At the same time, the emergence of generative artificial intelligence has opened a new chapter in the modernization of vocational education.

With powerful capabilities in data processing, multi-modal understanding, knowledge reasoning, and content generation, generative AI can provide tailored instructional support, produce scenario-based teaching materials, and deliver intelligent learning analytics [5]. This technological shift enables the dynamic renewal of curriculum resources, enhances teaching efficiency, and fosters students' independent learning and innovation abilities. When embedded in teaching platforms, generative AI also supports teachers in curriculum design, lesson preparation, practical simulation, and professional growth, thereby facilitating the transformation of educational roles and pedagogical paradigms. These advantages make generative AI an essential driver for constructing a new maritime-integrated talent training model that embodies both digital intelligence and industry orientation.

Against this backdrop, this study explores how generative AI can empower the reform of information-related programs with maritime characteristics. It constructs a systematic framework for teaching resource development, intelligent instructional innovation, faculty competency enhancement, and industry-education integration. The goal is to reshape the talent cultivation system, improve alignment with smart shipping development, and provide a replicable model for vocational colleges nationwide.

## 2. Literature Review

International research on artificial intelligence in education has grown rapidly in recent years, particularly in the context of generative AI. Scholars emphasize that AI is not merely a technological tool but a catalyst for educational transformation. Studies from MIT, Harvard, and Cambridge University highlight the shift from teacher-centered instruction to learner-centered design, with AI enabling personalized learning pathways, automated content generation, and authentic scenario simulation. In the field of engineering and data science education, AI has been used to

support project-based learning, strengthen cross-disciplinary integration, and enhance students' problem-solving abilities in complex industrial environments [6-7]. Recent publications further note that AI-driven teaching environments allow students to simulate industrial processes, conduct data analytics, and evaluate system performance in a manner aligned with real-world job demands.

In vocational education, international research underscores the importance of integrating AI technologies into competency-based training frameworks. Many studies identify AI as a strategic driver for bridging skill gaps through intelligent tutoring systems, adaptive assessments, and dynamic curriculum generation. Digital apprenticeship models and AI-powered learning companions have also emerged as effective tools for increasing students' engagement and supporting self-regulated learning. These research trends provide valuable insights for developing maritime-integrated teaching resources and fostering industry-specific digital skills.

Domestically, the transformation of vocational education has been strongly supported by national policies such as the Education Modernization 2035, Digital China Construction Plan, and the Action Plan for Vocational Education Digitalization [8]. Research on generative AI in education has expanded rapidly, examining its value in digital textbook development, intelligent teaching platforms, and resource construction. Studies emphasize that AI can streamline instructional design, reduce the cost of resource development, and enhance teaching accuracy and responsiveness. Meanwhile, curriculum-based ideological and political education has received increasing attention, with scholars advocating for the integration of national strategies, professional ethics, and value formation into specialized courses.

While significant progress has been made, current research still shows gaps in the construction of AI-supported teaching resources tailored to specific industries. Few studies systematically address the needs of smart shipping, where domain complexity, real-time data requirements, and operational constraints demand highly specialized instructional models. Moreover, the deep integration of AI with industry-education cooperation, project-based teaching reform, and faculty development remains underexplored. These gaps indicate the need for a comprehensive, generative AI-empowered framework that specifically targets talent cultivation for the maritime industry.

### **3. Generative AI-Empowered Maritime-Integrated Talent Training Model**

#### **3.1. Theoretical Foundation and Framework of Model Construction**

The development of the generative AI-powered integrated maritime teaching model is grounded in the theories of smart education, competency-based education, and industry-education integration. Smart education emphasizes the use of digital technologies to provide personalized, flexible, and data-driven learning experiences. Competency-based education focuses on aligning learning outcomes with workplace needs, ensuring that the teaching system cultivates both technical skills and professional qualities [9-10]. Industry-education integration highlights the deep

collaboration between educational institutions and enterprises, enabling the dynamic alignment of curriculum content, practical training, and job competencies.

Generative AI enhances these theoretical foundations by enabling multi-modal data processing, intelligent feedback, scenario simulation, knowledge graph construction, and automated resource generation. These capabilities support the design of project-based course structures that reflect real-world maritime operational processes and allow for the deep integration of industry data into teaching content. Additionally, AI-driven intelligent tutors and learning analytics continuously monitor student progress, supporting personalized instruction and competency development.

Based on these theoretical considerations, this study proposes a generative AI-powered talent cultivation framework for maritime integration, consisting of four components. The first component is an intelligent teaching platform that integrates a maritime-specific large language model, a multi-modal knowledge base, and interactive AI agents. The second component is a project-based curriculum system that aligns with the operational chain of smart maritime scenarios. The third component focuses on teacher development pathways supported by generative AI tools, covering teaching, research, and industry services. The fourth component establishes mechanisms for industry-education collaboration to ensure that teaching content and student competencies remain synchronized with real-world maritime applications. Together, these components form a closed-loop system that supports the continuous improvement of teaching quality and industry relevance.

#### **3.2. Core Components: Intelligent Platform and Project-Based Curriculum System**

The intelligent teaching platform serves as the technological foundation of this model. Built on the institution's existing computing infrastructure and maritime datasets, the platform integrates a domain-specific large language model with multimodal data capabilities, covering data such as AIS data, port logistics records, waterway monitoring data, and vessel operational indicators. Through intelligent agents, the platform supports teaching content generation, lesson plan design assistance, scenario simulation, learning analytics, and competency assessment. By automatically generating project tasks, case libraries, code templates, and explanatory materials, the platform reduces the workload on teachers and ensures that teaching content is updated in real time based on industry developments.

Within this platform, the curriculum system is restructured into a project-based framework corresponding to the entire technical chain of smart maritime operations. Students engage in sequential tasks that simulate the data lifecycle: collection, transmission, storage, processing, analysis, and application. For example, learners use Hadoop, HBase, and Spark to build big data platforms; employ Flume and Sqoop to collect and migrate maritime data; conduct real-time processing through Kafka; and complete comprehensive analysis projects using Hive. Through these tasks, students develop engineering capabilities, logical thinking, and problem-solving skills directly applicable to industry environments. Generative AI supports dynamic adjustments to task difficulty, personalized feedback, and the creation of diverse practice datasets, enabling differentiated learning pathways.

### 3.3. Implementation Support: Teacher Development and Deep Industry-Education Integration Mechanisms

The model also regards teacher development as a critical component. Through the intelligent platform, teachers can access AI-generated teaching materials, maritime case analyses, and updates on domain knowledge. Intelligent assistants help teachers refine lesson plans, design assessment rubrics, and prepare project tasks. Teachers can also conduct industry-relevant research with the support of AI-driven data analysis and simulation tools. By incorporating teacher competency profiling mechanisms, the platform identifies gaps in digital literacy, industry knowledge, and instructional design skills, providing targeted professional development resources. This approach enhances teachers' ability to deliver high-quality instruction that reflects the latest technological and industrial advancements.

Deep industry-education integration is achieved through collaborative efforts with maritime enterprises to build knowledge bases, case resources, and project tasks. Enterprise data and operational scenarios are incorporated into the teaching system, enabling students to engage in authentic and meaningful practical activities. Generative AI helps transform complex maritime processes into teachable components and supports dynamic updates based on enterprise feedback. By aligning industry competency models with curriculum objectives, the system facilitates precise mapping between job requirements and student learning outcomes. The platform also supports intelligent talent profiling, thereby promoting more effective matching between graduates and enterprise job positions.

## 4. Conclusion

This study proposes a generative AI-empowered framework for talent cultivation in maritime-integrated information programs. By analyzing the challenges faced by vocational colleges in aligning curriculum content, teaching resources, and faculty competencies with the needs of smart shipping, the study develops a comprehensive model incorporating intelligent teaching platforms, project-based curriculum system, AI-supported faculty development, and mechanisms for deepening industry-education integration. The findings demonstrate that generative AI can significantly enhance the timeliness, relevance, and practicality of instructional resources, support personalized learning, and strengthen the connection between education and industry.

Looking ahead, future work will focus on improving the standardization and interoperability of domain-specific AI models, enhancing the integration of maritime ideological and political education into instructional content, and establishing mechanisms for sustained data sharing between enterprises and educational institutions. Continued exploration will aim to build richer simulation environments, develop advanced analytics tools for student competency assessment, and promote the broader application of AI-driven instructional innovation across various maritime-related specialties.

Through these efforts, vocational colleges can further strengthen their capability to cultivate high-quality technical and skilled personnel who contribute to the construction of a strong maritime nation and the high-quality development of smart shipping.

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