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A Maritime-Integrated Model for Teaching Resource Construction in Big Data Platform Deployment and Operation Courses

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Abstract

The rapid transformation of the shipping industry toward digitalization and intelligence has raised urgent demands for high-quality big data professionals with strong technical competence and a sense of social responsibility. This study proposes a three-dimensional teaching resource construction model for Big Data Platform Deployment and Operation courses in higher vocational colleges. The model integrates real-world maritime projects as the instructional context, curriculum-based ideological and political education as the value-oriented core, and generative artificial intelligence as a key enabling technology. Drawing on the needs of the smart shipping industry, the study systematically addresses existing shortcomings in teaching resource construction and details the development of project-based maritime teaching resources, the embedding of ideological and political elements under the national "Maritime Power" strategy, and the application of AI-driven tools for dynamic resource generation. The proposed approach aims to enhance students' technical capabilities and cultivate holistic competencies, offering practical insights for talent cultivation in the emerging smart shipping ecosystem.

Keywords

Vocational Education; Big Data Major; Big Data Platform Deployment and Operation; Project-Based Learning; Generative Artificial Intelligence.

1. Introduction

In recent years, the global economic landscape has undergone profound changes, with the digital economy emerging as a core driver of industrial development. As the "lifeline" of international trade, the shipping industry is undergoing a deep transformation towards digitalization and intelligence, with new-generation information technologies such as big data, artificial intelligence (AI), and the Internet of Things (IoT) increasingly integrated into shipping operations [1]. Smart shipping is gradually becoming the dominant trend in industry development. Big data processing platforms play a central supporting role in this process. On the one hand, they enable the real-time collection, cleaning, and integration of heterogeneous data from vessels, ports, and waterways, thereby providing shipping enterprises with a comprehensive data resource foundation. On the other hand, through dynamic analysis and visualization of key indicators such as transportation volume, meteorological conditions, equipment status, and energy consumption, big data platforms assist enterprises in optimizing vessel scheduling, improving port operation efficiency, predicting equipment failures, and formulating precise maintenance plans. These capabilities effectively reduce operational costs and safety risks [2]. Furthermore, when combined with AI models, big data platforms can facilitate the transition of shipping operations from experience-driven decision-making to data-driven and intelligent decision-making, providing essential technical support for the development of the smart shipping ecosystem. With the continuous implementation of China's

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"Maritime Power" strategies, the strategic importance of the shipping industry has become increasingly prominent, creating a pressing demand for versatile professionals who possess both maritime operational expertise and strong information technology skills. In particular, the construction and maintenance of big data platforms have become critical components of the digital transformation of shipping enterprises, placing higher requirements on talent cultivation in higher vocational colleges.

As the backbone of vocational education, higher vocational colleges shoulder the mission of providing technical and skilled professionals for industry development [3]. However, many institutions still face several challenges in constructing specialized teaching resources and innovating instructional models. First, course content updates lag behind, failing to align closely with the latest technologies in the shipping industry and thus unable to meet the comprehensive competency requirements of industry positions. Second, project-based teaching resources are scarce, limiting students' opportunities for practical training and their ability to address complex problems. Third, there exists a disconnect between ideological-political education and professional education, with insufficient integration of curriculum-based ideological elements, resulting in a need to strengthen students' national consciousness and professional ethics [4]. Fourth, the adoption of information-based and intelligent teaching tools remains inadequate, with limited effective use of AI, big data, and other technologies to drive teaching resource construction and pedagogical reform.

With the rapid development of artificial intelligence, particularly generative AI technologies, has created new opportunities for vocational education reform [5-6]. Leveraging large-scale language models, knowledge graph construction, and automated content generation, generative AI can enable the intelligent creation, personalized delivery, and dynamic updating of educational resources, providing a potential solution to the shortage of teaching resources and outdated course content. Meanwhile, curriculum-based ideological and political education has become a vital means of fulfilling the fundamental goal of moral education. Higher vocational colleges must align with the national Maritime Power strategy and systematically integrate values such as patriotism, social responsibility, and professional ethics into professional curricula, thereby cultivating high-quality technical and skilled talents with both moral integrity and technical competence.

The paper systematically investigates and analyzes this approach from three dimensions: the construction of maritime project-based teaching resources, the integration of ideological-political education under the Maritime Power strategy, and the application of AI in teaching resource development. The findings aim to provide valuable references for related institutions and specialized course construction in the context of smart shipping industry talent cultivation.

2. Integration of Smart Shipping Projects into Teaching Resource Development

The Big Data Technology program adopts a competency-based approach to curriculum development, aligning learning objectives with industry-required job capabilities. It constructs a teaching content system that integrates both the operational processes of maritime logistics and the technical skills of data processing. The construction of course resources adheres to a "project-driven, task-oriented" model, in which typical maritime scenarios are transformed into structured instructional projects, effectively enhancing students' engineering practice and job-readiness. The program follows a five-step resource development methodology that encompasses industry research, knowledge transformation, resource development, classroom implementation, and feedback evaluation. This closed-loop process ensures the scientific validity, adaptability, and continuous improvement of teaching resources, thereby supporting the cultivation of high-quality talent for the smart shipping industry.

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2.1. Course Objectives with Maritime Characteristics

The primary task of maritime project-based teaching is to define clear talent cultivation objectives, ensuring that the curriculum system aligns closely with the demands of the smart shipping industry. As shown in Figure 1, course objectives should be grounded in the national "Maritime Power" strategy, while balancing professional skills, vocational competencies, and value-driven education.

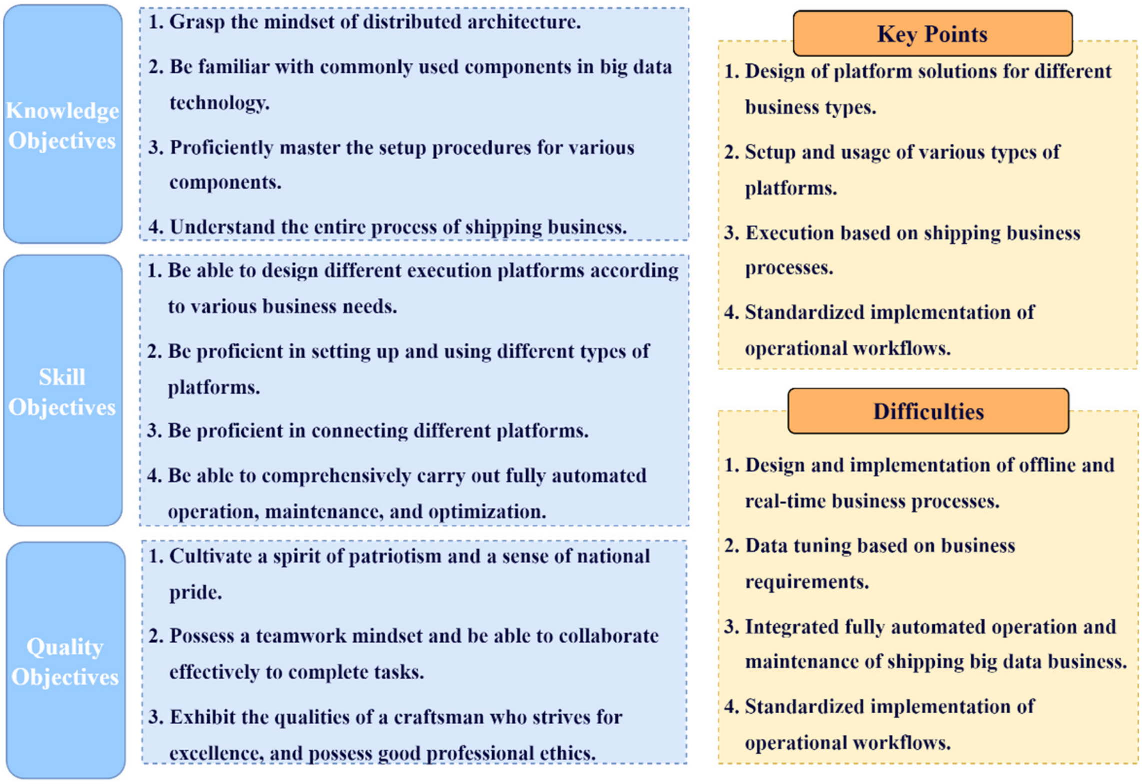

Figure 1. The teaching objectives with shipping characteristics

(1) Technical Skills Development Objectives

Equip students with core competencies in the construction, operation, and application of big data processing platforms. Students are expected to develop integrated capabilities in collecting, cleaning, storing, analyzing, and visualizing multi-source maritime data, and to proficiently apply information technologies to solve real-world problems in scenarios such as vessel management, port operations, and waterway control.

(2) Industry Insight and Professional Competency Objectives

Guide students to develop a deep understanding of the operational processes and developmental trends of the shipping industry. The goal is to enhance job readiness and interdisciplinary application abilities while fostering strong communication, collaboration, project management, and problem-solving skills that enable students to succeed in smart shipping–related positions.

(3) Value Formation and Sustainability Awareness Objectives

Integrate ideological and political education into the talent development framework by strengthening students' patriotism, awareness of green shipping, and sense of social responsibility. This objective aims to cultivate a strong sense of national mission and a mindset oriented toward sustainable development, enabling graduates to actively contribute to the industry's green transformation and high-quality advancement.

2.2. Course Contents with Maritime Characteristics

Based on the concept of maritime project-based teaching, the curriculum content is designed to embody the principles of "task-driven learning, real-world scenarios, and integrated data flow." The instructional approach focuses on cultivating students' comprehensive ability to solve practical problems in industry-aligned settings. To this end, the course is structured around a capstone project: the construction of a maritime big data analysis system. This system project serves not only as a central learning thread throughout the course but also as a framework for skill integration and assessment. The course design aligns closely with both the competency requirements of the Level-2 (Intermediate) Certificate in Big Data Operations and Maintenance (1+X program) and the technical standards outlined in the Big Data Technology and Application Skills Competition. By mapping course tasks directly to industry-recognized standards, the curriculum ensures both academic relevance and professional applicability.

As shown in Figure 2, the course is divided into seven progressive tasks. Beginning with the construction of a Hadoop-based data infrastructure (Task 1), students then advance through tasks involving storage system deployment using HBase and AIS data storage (Task 2), and computing platform setup with Spark (Task 3). This foundation enables subsequent instruction on data collection and migration using tools such as Flume and Sqoop (Task 4), and real-time AIS data transmission via Kafka (Task 5). These are followed by the establishment of a Hive-based data analysis platform (Task 6), culminating in Task 7—a comprehensive case study using Hive to perform end-to-end maritime data analytics.

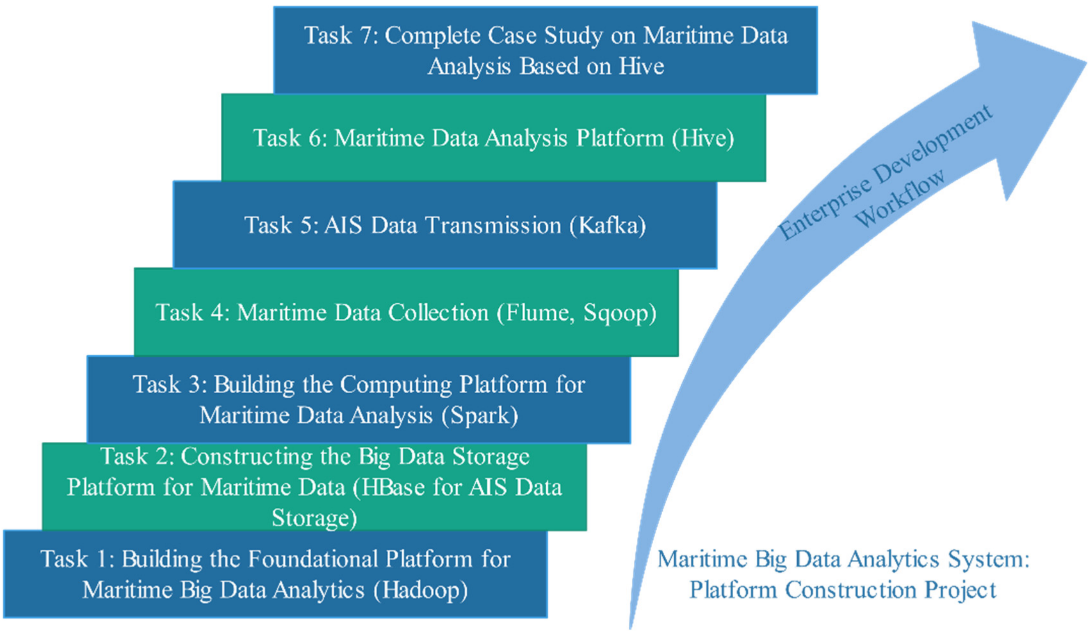

Figure 2. The course contents

Throughout the course, learners engage in the complete data lifecycle, including data acquisition, transmission, storage, processing, and visualization. This holistic, project-driven structure enables students to integrate theoretical knowledge with hands-on practice, building practical capabilities required for intelligent maritime operations.

2.3. Pathway for Teaching Resource Development with Maritime Characteristics

Teaching resource construction serves as the foundational support for maritime project-based instruction. Through practical experience, Jiangsu Maritime Institute has developed a five-step

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construction pathway: “Investigation – Transformation – Development – Implementation – Feedback.”

First, in-depth industry investigation is conducted to define the direction of resource development. Teaching teams collaborate with enterprise experts to conduct field research at ports and shipping companies, gathering insights into operational workflows, job competency requirements, and the current state of digitalization. This process helps identify key priorities for instructional content. Second, task transformation is carried out to design a project-oriented resource framework. Real business tasks are translated into educational projects, broken down into teachable and assessable units. Each unit is defined with clear learning objectives, simulated work environments, and evaluation criteria to ensure alignment with job competencies. Third, resource development focuses on building a multidimensional curriculum resource repository. This includes task sheets, case libraries, simulation systems, instructional videos, and structured datasets. The case library contains authentic maritime scenarios to support classroom discussion and extended practice. The data repository includes AIS datasets, port operation records, and vessel energy efficiency data, enabling hands-on experimentation and analysis. Additionally, a virtual simulation platform is developed to replicate scenarios such as port scheduling and ship navigation decision-making, enhancing students’ real-time operational and decision-making capabilities. Fourth, teaching implementation is conducted through school-enterprise collaborative application. Teaching resources are applied in both classroom instruction and workplace training, with enterprise mentors and academic instructors co-supervising students as they complete project tasks. This approach enhances the realism and professional relevance of learning activities. Finally, feedback and optimization enable dynamic resource updates. Student performance, enterprise input, and instructional evaluations are systematically reviewed to refine task design and resource content. This feedback loop ensures that teaching resources remain aligned with industry evolution and continuously improve in relevance and quality.

3. Integration of Maritime National Spirit into Teaching Resource Development

The Big Data Technology program remains firmly committed to cultivating core competencies for professionals in maritime data applications. It leverages the institution’s distinctive maritime culture, adheres to the principle of “all-around education,” and builds an integrated educational framework guided by the concept of “maritime-focused, multi-dimensional collaboration.” This framework bridges general education courses, ideological and political theory courses, professional modules, practical activities, and campus culture, resulting in unified educational goals, collaborative teaching efforts, and coherent learning outcomes.

3.1. The Strategic Importance of Maritime-Oriented Ideological and Political Education

Curriculum-based ideological and political education (IPE) serves as a vital vehicle for achieving the fundamental mission of moral education in Chinese higher education. In the context of China’s “Maritime Power” strategy, IPE embedded within maritime-specialized courses should be rooted in national strategic needs. It aims to integrate political education with maritime professional knowledge, foster students’ patriotism, professional ethics, and spirit of innovation, and strengthen their sense of responsibility and commitment to the mission of building a strong maritime nation.

3.2. Deep Integration of Maritime Ideological Elements

During the course resource development process, the Big Data Technology program actively identifies and integrates ideological elements embedded in maritime culture. Key themes include “Maritime Power,” “Green Shipping,” and the “Spirit of Craftsmanship.” In the course Big Data Platform Deployment and Maintenance, a project module themed around green shipping is designed to incorporate topics such as vessel energy efficiency and sustainable development in smart shipping. Through hands-on learning, students are immersed in the practical significance of contributing to the national maritime strategy.

3.3. A Multi-Dimensional Collaborative Model for Ideological Education

To further enhance the impact of curriculum-based IPE, the program has established an interdisciplinary, multi-stakeholder educational model. This model promotes synergy among general courses, political theory courses, professional studies, practical training, and campus culture, ensuring the comprehensive integration of ideological education. Additionally, a scientific evaluation system has been implemented, combining formative and summative assessments. This enables continuous tracking, feedback, and iterative improvement, ultimately forming a closed-loop mechanism for improving the effectiveness of talent cultivation.

4. Application of Generative AI in Teaching Resource Development

Generative Artificial Intelligence (AI), with its exceptional capabilities in content generation and intelligent interaction, offers transformative opportunities for curriculum design in vocational education. The integration of generative AI technology can significantly reduce the high cost and time required for traditional resource development. It enables rapid adaptation to the evolving demands of digital transformation in the maritime industry, thereby enhancing both the timeliness and practicality of teaching materials.

Jiangsu Maritime Institute has actively explored innovative applications of generative AI in the development of teaching resources. By leveraging real-world maritime data, the institute has developed domain-specific large models and intelligent teaching platforms tailored to the maritime field. These platforms use AI to dynamically generate a variety of curriculum resources, including interactive simulation scenarios, personalized instructional content, and real-time case repositories. This ensures precise alignment between educational materials and cutting-edge industry developments.

In classroom practice, instructors use the AI platform to design accurate, data-informed lesson plans and deliver content through intelligent resource recommendation, greatly improving teaching efficiency and effectiveness. On the student side, AI-generated personalized learning paths and practice-oriented simulation environments support self-directed learning and exploratory innovation. These capabilities contribute to the development of students’ autonomous learning skills, problem-solving abilities, and innovative thinking.

5. Conclusion

This study addresses the current limitations in maritime project-based teaching by conducting an in-depth analysis of talent demands within the shipping industry. It proposes an innovative three-dimensional pathway for teaching resource development—project-oriented in structure, ideological-political in core, and AI-assisted in implementation. Through ongoing practical exploration, the Big Data Technology program has preliminarily established a project-based teaching resource system with distinct maritime characteristics. This system has significantly enhanced students’ professional competencies and overall capabilities, marking an initial improvement in the quality of talent cultivation.

Future research will focus on further optimizing the construction of project-based resources, deepening the integration of curriculum-based ideological and political education, and systematizing the application of generative AI technologies. These efforts aim to continuously

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advance the development of maritime-specialized programs and vocational education reform, while cultivating more high-caliber technical professionals who possess both strong practical skills and a deep sense of national commitment, thereby contributing to the high-quality development of the smart shipping industry.

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