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Developing and Implementing an AI General Education Curriculum in Higher Vocational Education under the AI4M Framework

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Abstract: The accelerating integration of artificial intelligence (AI) into shipping operations and services places new demands on higher vocational students' technological understanding, tool use, human–AI collaboration, and ethical judgment. Addressing weak connections between general knowledge and discipline-specific tasks, insufficient adaptation of industry resources for teaching, and limited support for assessing learning processes, this study examines AI general education at Jiangsu Maritime Institute. Drawing on policy and literature analysis and existing curriculum development materials, it proposes an approach guided by AI4M (AI for Maritime). The Institute establishes a three-tier "1+M+N" curriculum comprising one compulsory general education course, M electives addressing mainstream application scenarios, and N industry cases and experimental packages. Teaching is organized through maritime scenario integration, the cultivation of maritime professional values, industry–education collaboration, and project incubation linked to competitions. Standardized resource packages, digitally enhanced textbooks, teaching agents, and formative and value-added assessment provide implementation support. This approach offers a practical pathway for vocational institutions with an industry focus to connect AI general education with discipline-specific education.

Keywords: AI4M; Higher Vocational Education; AI General Education; Integration of General and Discipline-Specific Education; Maritime-oriented Education; Digitally Enhanced Textbooks.

1. Introduction

As a major driver of the latest scientific and technological revolution and industrial transformation, AI is profoundly influencing national innovation capacity, industrial organization, and socioeconomic development. Advances in generative AI and AI agents are extending applications from information recognition and content generation to business analysis, workflow coordination, and decision support, continuously reshaping production methods and job tasks. The State Council's Opinions on Further Implementing the "AI Plus" Initiative calls for extensive and in-depth integration of AI across economic and social sectors and the accelerated development of an intelligent economy and society characterized by human–AI collaboration and cross-sector integration [1]. In shipping, the expansion of smart ports, smart waterways, and intelligent vessel operation and maintenance creates new requirements for data processing, intelligent tool use, and interdisciplinary collaboration [2]. These industry-level changes translate into new demands on talent development, requiring vocational education to respond promptly to evolving occupational competency structures.

In response, AI literacy is becoming an essential foundation for future career development, participation in society, and lifelong learning. It encompasses not only an understanding of basic AI concepts and technological characteristics, but also the ability to select tools for specific tasks, collaborate effectively with AI, critically evaluate generated outputs, and assume relevant ethical responsibilities [3–6]. For skilled personnel working directly in production and frontline services, AI literacy affects their ability to integrate new technologies into professional practice while maintaining independent judgment and adherence to operational standards in complex situations. AI education therefore needs to expand from knowledge instruction for a small number of technical disciplines to literacy development for all students. The Opinions on Accelerating Education Digitalization, issued by the Ministry of Education and eight other departments, proposes developing university AI general education courses that combine common foundations with distinctive institutional features [7]. The "AI Plus Education" Action Plan, issued by the Ministry of Education and four other departments, further calls for AI to become a common foundational subject in higher education and for the systematic design of AI-integrated programs, curricula, and teaching systems in vocational education [8]. These policies provide direction for coordinating AI general education with discipline-specific education in vocational institutions.

Driven jointly by policy and talent development needs, AI general education is moving beyond basic knowledge dissemination toward differentiated provision, scenario-based applications, and integration with disciplinary learning. Emphasizing the practical orientation of vocational education, Guan et al. propose a three-tier progression from general literacy to professional skills and industry competencies, providing a basis for connecting AI literacy with occupational competence [6]. Li et al. explore curriculum development that integrates general and discipline-specific education [9]. In institutional practice, Jinhua University of Vocational Technology adopts a progression combining foundational core courses, embedded AI literacy development, and deeper engagement with professional scenarios [10]. Shandong Institute of Commerce and Technology links AI literacy with occupational competence through modular content, project-driven teaching, and jointly developed industry–education resources [11]. Research at Nanjing Institute of Tourism and

Hospitality addresses tourism-related programs by establishing objectives for both general AI education and professional integration, exploring differentiated teaching and a three-stage, five-step teaching process [12]. These studies and practices indicate that AI general education should establish a shared competency foundation for all students while offering differentiated pathways aligned with disciplinary backgrounds and industry tasks. Supporting the sustained transfer of tool-use and human–AI collaboration skills into professional learning is thus a key priority for vocational institutions with an industry focus.

To address this issue, Jiangsu Maritime Institute proposes AI4M (AI for Maritime) in response to talent development needs in shipping, ports, vessels, and maritime services, connecting AI general education with disciplinary learning, job tasks, and professional standards. Building on its Introduction to Artificial Intelligence course, online course resources, and published companion textbook, the Institute develops a three-tier "1+M+N" curriculum comprising one compulsory general education course, M electives addressing mainstream applications, and N industry cases and experimental packages. The compulsory course focuses on foundational AI literacy and the use of AI agent tools. Electives apply agent technologies to mainstream tasks such as programming, office work, and data analysis. Industry cases and experimental packages are jointly developed across institutions and with enterprises and incorporated into discipline-specific teaching. By connecting shared foundations, scenario-based development, and industry applications, the curriculum explores a pathway from general tool operation to solving professional tasks, supporting the development of skilled personnel with combined AI and shipping competencies.

2. An AI4M-Guided Three-Tier "1+M+N" AI General Education Curriculum with a Maritime Focus

Guided by the maritime industry's digital and intelligent transformation, AI4M connects shared literacy requirements with discipline-specific application needs through a three-tier "1+M+N" curriculum, as shown in Figure 1. The "1" denotes Introduction to Artificial Intelligence, a compulsory course for all students at the foundational general education tier, focusing on basic AI literacy and AI agent tool use. The "M" denotes a set of electives addressing mainstream AI application scenarios at the skills development tier, using agent technologies to support programming, office work, data analysis, and creative production. The "N" denotes project cases and experimental packages developed for industry applications; this tier supports discipline-specific teaching through inter-institutional cooperation, joint development with enterprises, and collaboration among academic departments.

Progression across the three tiers involves increasing task complexity, disciplinary specificity, and student autonomy. The foundational tier enables students to understand basic AI characteristics, use agent tools, and conduct preliminary output checks. The skills development tier enables them to select tools, organize workflows, and complete tasks in particular scenarios. The industry application tier requires students to combine disciplinary knowledge, business data, and industry standards to analyze problems, validate solutions, and explain the scope of application and boundaries of responsibility.

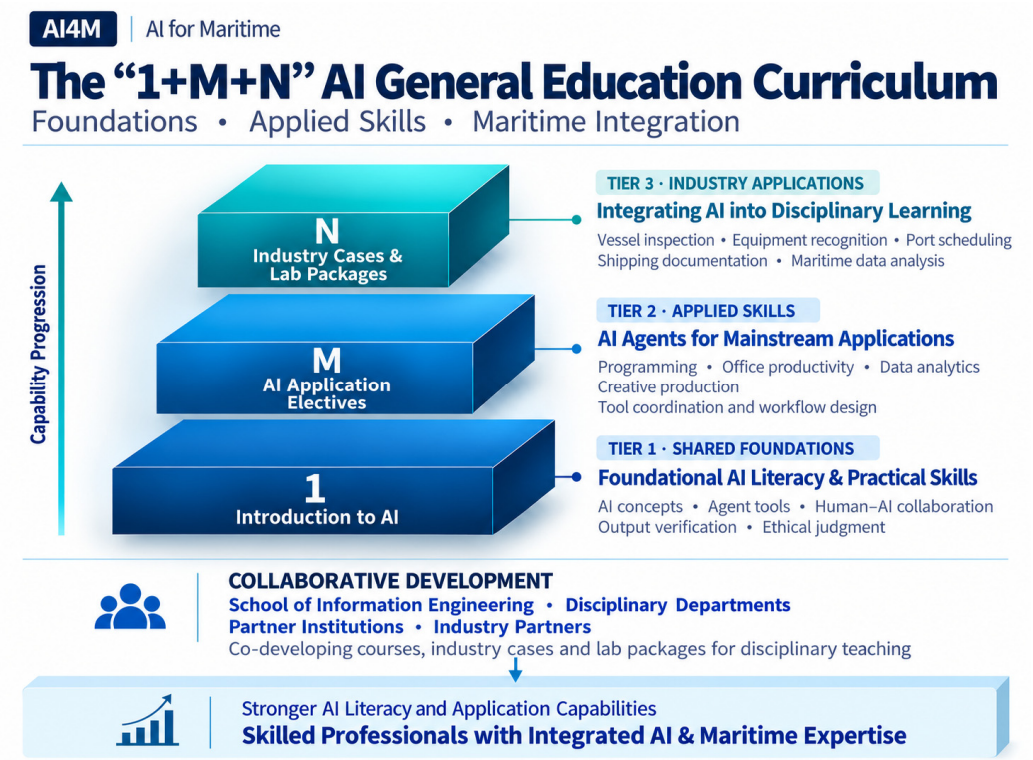


Figure 1. The AI4M-guided three-tier "1+M+N" AI general education curriculum

Curriculum development is led by the School of Information Engineering in collaboration with discipline-specific departments, partner institutions, and enterprises, establishing mechanisms for joint development, differentiated use, and ongoing updates. M and N represent expandable sets of courses and resources that can be configured according to

disciplinary needs, student preparedness, and teaching conditions; students are not required to complete identical numbers of courses or projects. Together, the three tiers strengthen AI literacy and application capabilities and support the development of skilled personnel with combined AI and shipping competencies.

2.1. One General Education Course for Foundational Literacy Development

Introduction to Artificial Intelligence is organized into four thematic units and eleven projects, progressing through understanding the AI era, practical skills, industry integration, and ethical inquiry. Projects begin with conceptual understanding and tools, use effective dialogue to support agent applications, and branch into multimodal creation, study planning, and intelligent office work. These capabilities are then transferred to industry understanding and professional tasks, while ethical debate and reflection provide feedback. Figure 2 presents the relationships of learning support and application transfer among the projects.

The course comprises four thematic units and eleven projects organized around introductory understanding, practical skills, professional transfer, and ethical reflection. Unit 1, "Opening the Future: Understanding Trends in the AI Era," uses Project 1, "Entering the AI Era," and Project 2, "Hands-on Use of Generative AI Tools," to introduce technological developments, occupational impacts, and capability boundaries and to establish basic tool-use and output-verification skills. Unit 2, "Building Foundations: Practicing AI Creative Skills," develops effective human–AI dialogue through Project 3, "Effective Prompting," and introduces WorkBuddy applications through Project 4, "Building Maritime AI Agents." This foundation supports three parallel branches: Project 5, "Creating Maritime Animated Short Videos"; Project 6, "Planning Three Years at a Maritime Institute"; and Project 7, "Using AI Agents for Workplace Tasks." These respectively develop multimodal creation, information integration and study planning, and intelligent office skills, moving students from tool operation to end-to-end task completion. Unit 3, "Integrating AI into Maritime Practice: Exploring AI Applications across Industries," uses Project 8, "Exploring AI-Enabled Industry Applications and Transformation," and Project 9, "Learning AI Applications in a Disciplinary Context," to examine changes in shipping, ports, and vessel-related occupations and explore applications in professional tasks, transferring general competencies to disciplinary contexts. Unit 4, "Meeting Challenges: Examining Emerging AI Ethics," uses Project 10, "Debating Technological Evolution and Emerging Ethics," and Project 11, "Reflecting on AI Ethical Challenges," to examine technological development and the boundaries of human and AI responsibility. Students review privacy, copyright, and content authenticity in their practical work and feed their reflections back into earlier projects, creating a learning cycle that connects competency development with ethical education.

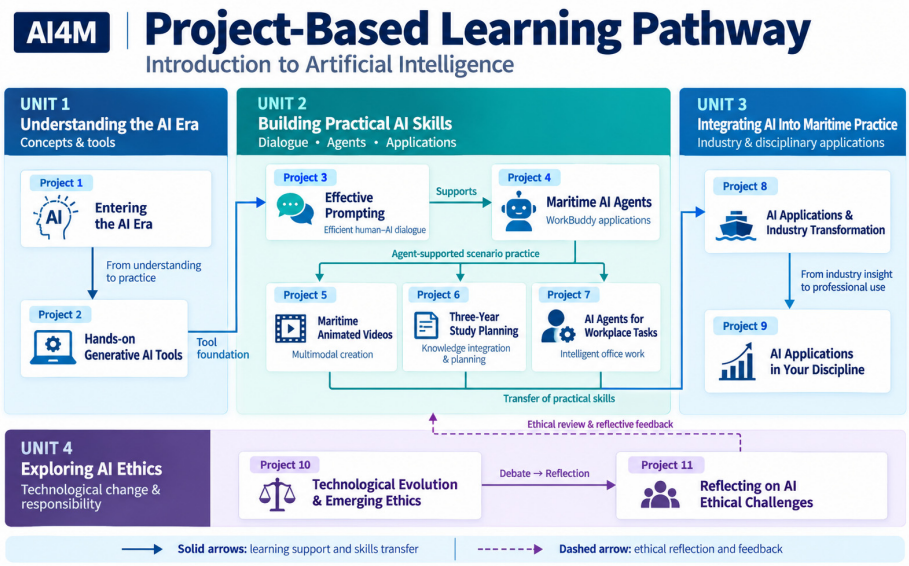


Figure 2. Project Connections and Learning Progression in Introduction to Artificial Intelligence under the AI4M Framework

2.2. M Elective Courses for Mainstream Application Scenarios

M AI electives address mainstream scenarios including office work, short-video production, data analysis, and intelligent programming. Building on the literacy and tool-use competencies developed in the compulsory course, they offer students from different disciplines needs-based pathways for progressively deeper learning. Typical tasks connect agent applications with scenario requirements, emphasizing task decomposition, tool coordination, process control, and output verification. Intelligent office courses cover document preparation, spreadsheet processing, presentation design, and email management, developing multi-tool coordination and workflow automation skills. Short-video courses integrate script development, image generation, video synthesis, AI voice-over, editing, and publication to develop multimodal content creation skills. Data analysis courses address data cleaning, statistical analysis, visualization, and report generation, strengthening data understanding and interpretation. Intelligent programming courses develop the ability to solve practical problems with agents through requirements specification, code generation, debugging, testing, and optimization. Courses accommodate both beginners and more experienced learners, incorporate authenticity checks, privacy protection, and copyright requirements into tasks, and assess task quality, operational processes, and improvements to outcomes. They enable students to progress from using individual tools to organizing human–AI collaborative workflows, laying a

foundation for subsequent professional learning and industry applications.

2.3. N Teaching Cases and Experimental Packages for Industry–Discipline Integration

The industry application tier connects general education with discipline-specific teaching through N teaching cases and experimental packages, jointly developed by the School of Information Engineering, disciplinary departments, partner institutions, and enterprises around typical occupational tasks. Cases integrate AI with disciplinary knowledge. Vessel inspection cases use image recognition and agents to assist in detecting equipment anomalies, organizing inspection records, and generating reports. Port automation cases cover container recognition, operational status monitoring, and comparisons of scheduling options, helping students understand intelligent technologies in port operations. Maritime customer service cases build knowledge bases from business guides and frequently asked questions to support inquiries, procedural guidance, and answer verification. Shipping documentation cases support information extraction, document checking, and standardized writing. Automatic Identification System (AIS) data analysis cases combine vessel trajectory visualization, navigation pattern analysis, and the identification of potential anomalies to develop data application skills. Each experimental package includes a business scenario, task requirements, de-identified data, operating instructions, and assessment criteria, with data scale and technical difficulty adjusted to student preparedness. Enterprises supply business requirements and application constraints, disciplinary teachers review occupational standards, and partner institutions participate in development and instructional adaptation. Data security, output verification, and human review are embedded throughout, producing continuously updatable resources that can be integrated into disciplinary courses and supporting the transfer of general AI capabilities to professional tasks.

3. Implementing the Joint Development of AI Capabilities and Maritime Professional Competencies under AI4M

AI4M integrates AI capability development into maritime education, using industry tasks to contextualize technological learning and professional requirements to guide responsible application. Teaching within the "1+M+N" curriculum is advanced through four dimensions: maritime scenario integration, the cultivation of maritime professional values, industry–education collaboration, and project incubation. These dimensions strengthen task-solving, human–AI collaboration, professional transfer, and integrated innovation capabilities, allowing AI learning and maritime professional development to reinforce each other.

3.1. Integrating Maritime Scenarios to Develop AI-Assisted Task-Solving Capabilities

AI4M coordinates AI capability training with maritime task practice by converting scenarios such as vessel inspection report generation, port operations data analysis, maritime customer service, and shipping documentation into teaching tasks. Instruction follows a sequence of requirements analysis, task decomposition, tool selection, collaborative execution, and output verification. Students identify the stages suitable for AI assistance and combine human–AI dialogue, knowledge bases, multimodal generation, and agent technologies to complete tasks. For vessel inspections, for example, students use AI to organize records, extract anomaly information, and generate reports, then check the results against source materials and occupational standards. In maritime customer service, organizing business materials, building knowledge bases, and testing questions and answers develop information organization and application improvement skills. Transferring similar methods across scenarios helps students understand the conditions under which tools are appropriate and progressively develop the ability to use AI to address professional problems.

3.2. Cultivating Maritime Professional Values to Develop Responsible Human–AI Collaboration

Maritime professional values and standards for AI use are embedded in project implementation. Authentic problems provide the starting point, task processes organize learning, and human–AI collaboration competencies form the central focus, encouraging students to assume responsibility for judgment and verification while using technology. The shipping sector's emphasis on safety, compliance, and cooperation is translated into concrete requirements for data authenticity, output reliability, privacy protection, and responsibility boundaries. In animated maritime video production, students check material sources, copyright, and the accuracy of maritime knowledge. In study planning, they distinguish institutional requirements, personal preferences, and model-generated recommendations. In inspection reports and business questions and answers, they trace the sources of key conclusions and conduct human reviews. Assessment considers not only completed work but also students' ability to explain AI involvement, identify output errors, and justify revisions. Continuous documentation, verification, and reflection cultivate prudent technology use, respect for professional judgment, and willingness to assume responsibility, developing AI application capabilities alongside maritime professional competencies.

3.3. Strengthening Maritime Industry–Education Collaboration to Develop AI Application Transfer Capabilities

Building on maritime program development and industry partnerships, enterprises, disciplinary departments, and partner institutions collaborate to transform typical business processes, de-identified data, and technical requirements into AI teaching resources. Enterprises provide occupational tasks, business constraints, and outcome requirements; disciplinary teachers specify prerequisite knowledge and operating standards; and AI teachers design tool applications and competency development activities. Together, they develop instructional plans that address both technological methods and professional requirements. Case development retains authentic business logic while adjusting data scale and implementation difficulty to student preparedness, creating tiered tasks that progress from introductory experience to workflow application and integrated improvement. Port automation cases, for example, can progress from recognizing operational information to analyzing data and comparing

scheduling options. Maritime customer service cases can progress from information retrieval to knowledge base maintenance, question–answer evaluation, and service process optimization. Joint guidance by teachers from different disciplines and enterprise feedback help students transfer general education tool-use methods into professional tasks and evaluate technological effectiveness against business requirements.

3.4. Incubating Maritime Projects to Develop Integrated AI Innovation Capabilities

Drawing on its maritime educational expertise and industry partnership platforms, the Institute establishes a resource development mechanism led by the School of Information Engineering, with participation from relevant disciplinary departments and support from partner institutions and enterprises. Information engineering teachers design AI methods and learning scaffolds, disciplinary teachers review business scenarios and standards, and enterprise personnel provide typical tasks, application constraints, and frontline feedback. Partner institutions participate in peer review and resource adaptation. Together, these stakeholders determine which tasks suit general education and which require disciplinary prerequisites, ensuring that industry cases retain authentic business logic rather than merely an industry label. Research outcomes require pedagogical adaptation before classroom use. In AIS data research, for example, data cleaning, anomaly detection, and indicator analysis can be converted into accessible tasks involving data comparison and interpretation. AI-supported resource development encompasses data authorization and de-identification, the formulation of business problems, control of learning difficulty, preparation of examples and task sheets, and review of assessment criteria, with both normal and anomalous examples provided. This approach preserves the authenticity of research problems while reducing algorithmic complexity and deployment burdens, allowing resources to be reused across disciplinary classes.

4. Resource Development under AI4M

To support the "1+M+N" curriculum and maritime-focused teaching, foundational general education resources, scenario-based application resources, and disciplinary case resources are developed in a coordinated manner. AI is integrated throughout resource development, textbook presentation, and learning support.

4.1. Developing Modular Teaching Resources Aligned with Curriculum Tiers

Resources are organized around foundational general education, scenario-based development, and industry applications. The foundational tier covers AI understanding, human–AI dialogue, agent applications, and ethical judgment through microlectures, demonstrations, task guides, and self-assessment questions, helping students acquire basic concepts and methods. The scenario-based tier addresses intelligent office work, short-video production, data analysis, and intelligent programming, providing task materials, tool-use examples, workflow templates, and assessment criteria to support complete practice from requirements specification to output verification. The industry application tier addresses vessel, port, and maritime service needs through case resources containing business backgrounds, de-identified data, occupational standards, and experimental guidance. Knowledge points, competency requirements, and application scenarios connect the tiers, enabling students to progress from foundational learning to scenario practice and then select cases according to disciplinary needs, supporting continuity and resource reuse across courses.

4.2. Developing Maritime-Focused digitally enhanced textbooks around Project-Based Learning

The AI general education textbook follows the four thematic units and eleven projects, connecting AI knowledge with maritime learning tasks. Each project includes task introduction, prerequisite knowledge, practical operations, outcome verification, and further reflection, explaining both how to operate tools and why particular tools and judgments are appropriate. Printed textbooks are paired with digital resources: print content emphasizes basic principles, task logic, and professional standards, while digital content includes instructional videos, interactive exercises, tool updates, and extended cases, connected through QR codes or course links. Given the rapid iteration of AI tools, relatively stable knowledge and methods are organized separately from changing tool operations to facilitate targeted updates.

4.3. Providing AI-Assisted Resources to Support Independent Learning

Textbooks, curriculum standards, operating guides, and frequently asked questions form a course knowledge base that supports learning agents offering explanations, resource navigation, operational prompts, and exercise feedback. Differentiated tasks address differences in student preparedness: beginners receive step-by-step guidance and basic exercises, while more experienced students undertake workflow optimization and integrated tasks. AI-assisted learning emphasizes guidance and inquiry, prompting students to clarify task objectives, identify verification evidence, and compare solutions so that they can analyze problems independently. Responses involving professional standards, critical data, or ethical responsibilities are linked to verifiable course materials, and channels for teacher feedback are provided. Student questions, exercise errors, and revisions to work help identify common difficulties and inform targeted explanations and examples, connecting learning support with classroom teaching.

5. Conclusion

Jiangsu Maritime Institute develops a "1+M+N" AI general education curriculum consisting of one compulsory general education course, M electives addressing mainstream scenarios, and N disciplinary teaching cases and experimental packages, progressing from general foundations through scenario-based development to industry applications. Building on this structure, it explores implementation through maritime scenario integration, the cultivation of maritime professional values, collaborative industry–education development, and course project incubation, promoting the coordinated development of AI-assisted task-solving, human–AI collaboration, professional transfer, and integrated innovation capabilities. Modular resources, digitally enhanced textbooks, and AI-assisted learning are developed in response to curriculum and teaching needs, with improved mechanisms for collaborative development, review and

evaluation, and ongoing updates, supporting the integrated development of AI capabilities and maritime professional competencies.

Looking ahead, AI will continue to reshape knowledge acquisition, production organization, and occupational competency structures, requiring AI general education to evolve accordingly. Higher vocational institutions should keep pace with developments in multimodal large models, agents, and embodied AI, examine their deeper implications for industry tasks and talent development, and continuously update course content, practical activities, and assessment methods. Greater attention should be paid to independent learning, critical thinking, interdisciplinary collaboration, and responsible innovation. Further cooperation across institutions and disciplines and with enterprises should promote the joint development and sharing of high-quality resources. Sustained educational research should evaluate learning outcomes and embed AI education throughout talent development, preparing skilled personnel with multidisciplinary competencies who can adapt to technological change and contribute to industrial innovation, smart shipping, and China's development as a strong transportation and maritime nation.

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