ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202411_7(11).0001

# Research on the New Ecological Path for Cultivating Innovative Maritime Talent through Industry-Education-Research Integration

Shiguan Liao[1], Zhaomin Zhang[1], Ji Li[2,*]

[1]School of Management, Shenzhen Polytechnic University, Shenzhen 518055, China

[2]Office of Academic Research, Shenzhen Polytechnic University, Shenzhen 518055, China

[*] Corresponding author: liji@szpu.edu.cn

## Abstract

**In the context of new engineering education, the integration of industry, education, and research (IER) is an inevitable trend for cultivating application-oriented talent in higher education institutions. This integration not only enhances the alignment between academic training and local industrial needs but also fosters innovative capabilities essential for the evolving maritime sector. This study identifies the critical components of successful IER integration and proposes actionable strategies such as university-enterprise cooperative education and the comprehensive enhancement of innovative talent cultivation through curriculum reforms. Key suggestions include the establishment of robust joint education mechanisms, the development of interdisciplinary and application-oriented course systems, and the promotion of modern teaching models that emphasize practical skills and innovative thinking. Furthermore, this research underscores the importance of active enterprise participation and the formulation of targeted national policies to incentivize maritime companies to engage in educational collaborations.**

## Keywords

**Industry-Education-Research; Talent Cultivation; Maritime; Innovative Talent.**

## 1. Introduction

According to the National Medium and Long-term Education Reform and Development Plan (2010-2020), China is in a critical period of reform and development, with steady progress in economic, political, cultural, social, and ecological civilization construction[1]. The ongoing processes of informatization, urbanization, and marketization, alongside increasing pressures related to population and environment, highlight the importance and urgency of improving national quality and cultivating innovative talent. The shortage of innovative talent also constrains China's international competitiveness. The port and shipping (maritime) disciplines, as focal points of engineering application education, aim to cultivate highly competent maritime professionals with strong operational abilities and innovative consciousness[2]. Given the rapid technological development and the deepening of international trade and cross-industry cooperation, maritime education has become crucial. Joint opinions from multiple departments, such as the Ministry of Transport and the Ministry of Human Resources and Social Security, emphasize the significant role of university-enterprise cooperation in fostering high-quality seafarers through in-depth IER integration and promoting an order-based cultivation model to enhance seafarers' vocational quality. Despite the high-quality development of vocational education, various educational challenges remain unresolved. Optimizing the positioning of vocational education and overcoming its developmental issues have risen to the level of major

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202411_7(11).0001

national strategic decisions. The 2014 State Council's decision on accelerating the development of modern vocational education underscores IER integration and distinctive education as fundamental principles for vocational education development, emphasizing cooperation between vocational schools and enterprises. This cooperation focuses on serving regional economic development, particularly for small and micro enterprises, and strengthening community education and lifelong learning services. This context calls for universities and enterprises to collaboratively cultivate innovative maritime talent through application-oriented research projects, enhancing students' practical and innovative abilities and supplying enterprises with high-quality technical talent.

Currently, abroad, the integration of industry and education, commonly known as industry-education integration, has become a standard practice[3–5]. However, with the rapid technological advancements, the existing higher education system reveals deficiencies, such as insufficient self-regulation and a lack of innovation motivation, making it difficult to meet societal development and talent demands. Breen emphasizes the need to establish excellent industry-education cooperative relationships amid continuous industrial changes[6]. Schools, enterprises, and the government all play crucial roles in this process. Many scholars have explored various models of IER talent cultivation from different perspectives, indicating that in the school-government-enterprise IER model, the government primarily plays a guiding role, while schools rely on enterprises to build IER demonstration institutions[7–9]. The current market's talent demands are often reflected in dimensions such as experience, education, and qualification levels. For maritime talent cultivation, it is essential to consider the requirements of higher engineering education, the vocational attributes of maritime work, and the development gaps. By leveraging professional skill applications, practical ability training, and international perspectives, the goal is to cultivate high-quality talent that meets societal development needs.

In recent years, China has vigorously promoted strategies like Building a Strong Transportation Nation and Building a Strong Maritime Nation, making the enhancement of comprehensive quality and the cultivation of interdisciplinary talent in maritime education a common goal among educators. The maritime profession's theoretical significance, comprehensive nature, broad knowledge framework, and stringent practical requirements necessitate a close integration of practical training with academic education and professional skill reserves. The IER integrated model for cultivating innovative talent is crucial for achieving a win-win scenario between vocational schools and enterprises. Vocational schools, as major forces in regional technical skills aggregation, practical innovation, and dissemination, mainly see their graduates employed by enterprises. Enterprises must innovate to maintain their competitive edge, and innovation heavily relies on innovative talent. Thus, innovative talent is pivotal for the survival and development of enterprises. Only by genuinely cultivating a substantial number of innovative talents can vocational schools meet the developmental needs of enterprises, leading to their continuous growth and expansion.

This paper addresses the issues in traditional maritime talent education, such as an overemphasis on knowledge logic, detachment from industrial demands, outdated curricula, lack of practical experience among some teachers, insufficient student innovation and practical abilities, and discrepancies between professional standards and enterprise needs. It explores reform strategies in teaching models, curriculum arrangements, and faculty strength of modern maritime colleges. Additionally, it investigates new paths combining deep IER integration and innovative maritime talent cultivation to resolve mismatches between talent cultivation positioning and societal talent demands, local economic improvements, and systematic and targeted aspects of talent cultivation design. The goal is to enhance the educational level of maritime disciplines and promote the planning and construction of modern maritime colleges.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202411_7(11).0001

# 2. Characteristics of Modern Maritime Higher Education

## 2.1. Core Curriculum Design Reflecting Industry Characteristics

Modern maritime higher education's core curriculum design leverages the modern shipping industry as its foundation, focusing on both theoretical teaching and practical activities to continually enhance students' hands-on capabilities through experiments and practical operations. Table 1 shows the core curriculum components that are critical in modern maritime education, providing a structured overview of what students are expected to learn and the skills they are expected to develop. It helps to demonstrate the comprehensive and practical nature of maritime education, emphasizing the importance of both theoretical knowledge and hands-on experience.

**Table 1.** Core Curriculum Components in Maritime Education

| Component | Description | Skills Developed |
|---|---|---|
| Practical Skills | Emphasis on operational skills, use of navigational electronic equipment, emergency handling | Operational proficiency, problem-solving |
| Professional Knowledge | In-depth understanding of mathematics, physics, mechanics, and technical skills | Technical expertise, analytical thinking |
| Comprehensive Coverage | Broad range of topics including ship control, legal safety, ship design | Versatility, broad knowledge base |
| International Orientation | Focus on international trade, national laws, safety standards, and cross-cultural communication | Global perspective, regulatory knowledge |

The core curriculum's comprehensive, practical, and international traits significantly aid students' career development, particularly in the following aspects:

Pronounced Practicality: Maritime positions demand high operational skills from students, such as standardized operation of navigational electronic equipment and effective handling of emergencies. Hence, the core curriculum emphasizes practical skills development through field investigations and simulation exercises, achieving a deep integration of theory and practice.

High Professional Skill Requirements: Maritime students must possess a deep understanding of fundamental disciplines like mathematics, physics, and mechanics, alongside excellent technical skills and professional qualities. Thus, the core curriculum covers many practical aspects, focusing on developing students' professional skills and familiarity with safety theory systems.

Broad Coverage: To meet industry demands effectively, the core curriculum encompasses a wide range of topics such as ship control, legal safety, and ship design. It aims to foster students' diversified knowledge and skills.

Significant International Characteristics: The maritime profession links the ocean with international trade, so the core curriculum often has an international orientation, closely related to national laws, international safety standards, and cross-cultural communication, significantly aiding students' global perspective development.

## 2.2. IER Integrated Collaboration

To efficiently promote the combination of practical and innovative work, maritime colleges collaborate with relevant enterprises for regular discussions and cooperation. They consider industry trends and market changes, alongside practical course conditions and faculty strength,

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202411_7(11).0001

to build an IER integrated research platform. Table 2 outlines various IER integrated collaboration projects, detailing the participants, goals, outcomes, and impact of each project. It highlights the collaborative efforts between maritime colleges and industry partners, showcasing the practical applications of research and the tangible benefits of these collaborations. This table underscores the importance of IER integration in driving innovation and improving the overall quality of maritime education and industry practices.

**Table 2.** IER Integrated Collaboration Projects and Outcomes

| Project | Participants | Goals | Outcomes |
|---|---|---|---|
| Ship Design Innovation | Maritime College, Shipyards | Develop new ship designs with enhanced efficiency | Successful development of eco-friendly ship models |
| Navigation Simulation Training | Maritime College, Shipping Companies | Enhance practical navigation skills through simulation | Creation of advanced simulation training programs |
| Safety Management Systems | Maritime College, Port Authorities | Develop and implement advanced safety protocols | Development of comprehensive safety management systems |
| International Trade Logistics | Maritime College, Trade Organizations | Improve logistics management in international trade | Implementation of efficient logistics strategies |

This collaboration effectively translates research achievements into productive forces and aligns with social needs, laying a solid path for cultivating highly competitive talent. Currently, IER integrated cooperation in maritime colleges primarily manifests the following characteristics:

Targeted Talent Cultivation: IER integration focuses on high-level talent cultivation according to maritime development needs. Colleges and enterprises jointly formulate talent cultivation plans, clarify theoretical course settings and graduation requirements, combining the latest industry trends with practical skills for effective student cultivation and systematic knowledge framework construction.

Innovative IER Integration Development: Maritime colleges maintain close IER cooperative relationships with various shipping enterprises, aiming to address practical technical and managerial deficiencies. Through cooperative research projects, both the academic and skill levels of college teachers and enterprise employees are significantly enhanced, accelerating the transformation rate of scientific achievements and tightly linking maritime talent innovation with technological skill accumulation and shipping enterprises.

Shared Research Achievements: Colleges and enterprises share their research achievements through academic conferences, collaborative publications, and other means, fostering continuous progress and ensuring enterprises' sustained technological innovation vitality while supporting efficient ongoing research.

Dynamic Adjustment of Resources: During IER cooperation, colleges can collaborate with industry associations and relevant research institutions to steadily build cross-disciplinary, multi-party cooperative methods, dynamically adjusting resources according to actual needs to achieve shared resource and collaborative development goals.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202411_7(11).0001

# 3. Current Status Analysis of Innovative Maritime Talent Cultivation Models

## 3.1. Need for Differentiated Talent Cultivation Models

Amid the rapid development of various aspects of Chinese society, the maritime field urgently requires the integration of diverse types of maritime talent to meet its construction needs. Maritime talent is cultivated across different educational levels, including vocational, associate, and undergraduate degrees, leading to differences among students. Different maritime colleges should demonstrate personalized and targeted characteristics in their cultivation methods for innovative maritime talent. Under the student-centered educational philosophy, it is crucial to respect and meet students' diverse career development plans and self-development goals. Additionally, building a differentiated maritime talent cultivation model that involves government, schools, and shipping enterprises in a collaborative approach is necessary.

## 3.2. Cognitive Biases in Understanding Innovative Talent

Although the importance of innovative talent is widely recognized, there is no consensus on the essence of cultivating innovative talent and how to effectively conduct such cultivation. This misunderstanding is reflected in three areas: defining innovative talent based solely on academic levels (academic level equals innovation), equating intelligence with innovative talent, and confusing general national quality with specific innovative talent qualities. These cognitive biases lead to cultivation missteps. Despite various measures taken by maritime colleges to cultivate innovative talent from different angles, the traditional knowledge-centric cultivation model has not fundamentally changed. Students still face the challenge of finding their in-school knowledge outdated after graduation, indicating that a genuine IER integrated model for cultivating innovative maritime talent has yet to be established.

## 3.3. Unstable Foundation for IER Collaboration in Cultivating Innovative Talent

High vocational, associate, and vocational bachelor's maritime colleges must actively explore new IER collaboration mechanisms to innovate maritime talent cultivation. Both colleges and enterprises should work together to establish effective IER collaboration mechanisms for cultivating innovative maritime talent, ensuring smooth talent supply. However, many maritime colleges still operate under an education system centered on knowledge logic, making it challenging to establish a new paradigm that combines knowledge logic and professional logic organically. Additionally, collaborative efforts to foster innovative maritime talent through cooperative education, cooperative research, and research achievements are still inadequate.

## 3.4. Lack of Active Enterprise Participation in IER Integration for Cultivating Innovative Talent

Although colleges clearly recognize the importance of close cooperation with enterprises for cultivating high-quality, innovative maritime talent through IER integration, maritime enterprises are often hesitant to actively participate. Factors such as input-output ratio, cost-effectiveness, and the considerable time and effort required for collaboration contribute to this reluctance. Additionally, there is significant uncertainty and mismatch regarding whether the costs invested in talent cultivation will lead to successful alignment with enterprise needs and smooth employment outcomes. This perceived unfairness makes enterprises less willing to engage in such collaborations. Another major issue is the integration of resources between colleges and enterprises into the talent cultivation process. To effectively build a robust system for cultivating innovative maritime talent through IER integration, it is essential to develop targeted national policies to incentivize maritime enterprises. Furthermore, promoting the substantial value of vocational education in maritime colleges for accelerating the development

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202411_7(11).0001

of enterprises and the industry is crucial, helping enterprises truly appreciate the profound significance of college-enterprise cooperation.

## 4. Exploring the Path for Cultivating Innovative Maritime Talent

### 4.1. Strengthening Curriculum System Construction and Implementing Order-based Cultivation Mode

Maritime colleges should begin by identifying the specific needs of the maritime industry to ensure the curriculum is aligned with current and future demands. Developing a robust curriculum framework that IER principles is essential. The focus should then shift to designing application-oriented courses that emphasize practical skills and knowledge. Training and hiring interdisciplinary faculty are crucial to deliver diverse perspectives and expertise. Establishing project research teams will enhance teachers' research abilities and ensure the curriculum remains relevant and innovative. The curriculum should be implemented and regularly assessed to ensure it meets the desired outcomes, with continuous improvement based on feedback from all stakeholders.

### 4.2. Reforming Teaching and Learning Models to Promote Practical Skills and Innovative Capabilities

To reform teaching and learning models, maritime colleges should start by optimizing teaching content to ensure it is relevant and engaging. Developing application-oriented courses that focus on practical skills is key. Implementing interdisciplinary curriculum designs and establishing course module sets will provide students with a well-rounded education. Introducing problem-based learning (PBL) will foster critical thinking and problem-solving abilities. Creating skill competition platforms and organizing regular competitions will help students apply their knowledge in practical settings and enhance their innovative capabilities. Regular evaluation and enhancement of teaching methods are necessary to maintain high educational standards and adapt to evolving industry needs.

### 4.3. Deepening Enterprise Participation and Exploring Effective IER Integration Models

Maritime colleges should deepen cooperation with enterprises by establishing robust joint education mechanisms. Conducting regular enterprise lectures will provide students with industry insights and real-world knowledge. Developing comprehensive internship programs will offer students hands-on experience in maritime settings. Initiating collaborative research projects between colleges and enterprises will drive innovation and practical application of research findings. Creating graduate employment platforms will facilitate smooth transitions from education to employment. Integrating feedback from enterprises will ensure the relevance and effectiveness of the IER collaboration models. Continuous improvement of these models based on feedback and industry trends is essential. Promoting successful collaborations will highlight the benefits and encourage further participation from enterprises.

## 5. Conclusion

In conclusion, the new ecological path for cultivating innovative maritime talent through IER integration requires a collaborative approach among government, schools, and enterprises. By strengthening curriculum systems, reforming teaching models, and deepening enterprise participation, maritime colleges can effectively cultivate high-quality, innovative maritime talent. This approach not only addresses the challenges in traditional education models but also meets the evolving demands of the maritime industry, ensuring sustainable development and technological advancements.

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202411_7(11).0001

## Acknowledgments

Funding: This research was supported by the Research Foundation of Shenzhen Polytechnic University under Grant 6023312017K.

## References

[1] Naustdalslid J. Circular economy in China – the environmental dimension of the harmonious society[J]. International Journal of Sustainable Development & World Ecology, 2014, 21(4): 303–313.

[2] Ma C. Research to improve maritime education and training for energy efficient ship operation in China[J]. World Maritime University Dissertations, 2018.

[3] Liao H. Internal Logic and Implementation Ways of Industry-Education Integration[J]. CONVERTER, 2021: 658–666.

[4] Xin H, Yang Q, Zhong C, et al., Training Path of International Talents in Smart Manufacturing Under the Background of Integration of Industry and Education[J]. Advances in Intelligent Systems, 2023, 158: 845–856.

[5] Kong M, Kuang Y, Zhang Z. Exploration and Reflection on the Development of Internationalized Industry-Education Integration of Vocational Education in the Context of Big Data[J]. Applied Mathematics and Nonlinear Sciences, 2024, 9(1): 20241292.

[6] Breen H. An Investigation of Professional Development Education for Tourism and Hospitality Employees Through University and Industry Cooperative Education Partnerships[J]. Journal of Teaching in Travel & Tourism, 2002, 2(3–4): 1–22.

[7] Haiyan Q, Allan W. Creating conditions for professional learning communities (PLCs) in schools in China: the role of school principals[J]. Professional Development in Education, 2021, 47(4): 586–598.

[8] Wang G, Li Y, Zuo J, et al., Who drives green innovations? Characteristics and policy implications for green building collaborative innovation networks in China[J]. Renewable and Sustainable Energy Reviews, 2021, 143: 110875.

[9] Zheng Z, Pan Y, Li L. Team Construction and Cooperation Mechanism of Virtual Teaching and Research Office of Logistics Specialty in the Information Age[J]. Advances in Artificial Systems for Medicine and Education, 2023, 159: 436–447.