

Research on the Construction and Practical Path of AI-Driven Personalized Learning in Maritime English

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Abstract: Aiming at the core pain points in Maritime English teaching of higher vocational colleges, namely the huge gap in students' basic abilities, the disconnection between teaching content and professional job requirements, and the lack of targeted personalized guidance, this study takes the development opportunity of the integration of artificial intelligence (AI) technology and maritime education as the starting point. Focusing on the construction and practical implementation of the personalized Maritime English learning system, it systematically analyzes the current teaching situation of Maritime English and the characteristic demands of personalized learning, constructs a four-dimensional integrated personalized learning system, and designs a closed-loop practical path with four progressive stages. Empirical results show that the implementation of this system and path has significantly enhanced students' learning engagement in Maritime English and remarkably improved their professional knowledge application capabilities. The research results provide an original and operable practical scheme for the teaching reform of Maritime English, and further enrich the research dimensions of intelligent technology empowering vocational foreign language education.

Keywords: Artificial Intelligence, Maritime English, Personalized Learning, System Construction, Practical Path.

1. Introduction

Maritime English acts as an indispensable critical link connecting professional maritime knowledge with international maritime practice. Its teaching quality not only directly determines the efficiency of students in obtaining professional competency certificates, but also is a core guarantee for the safety of future maritime navigation operations, thus serving as a foundational core course for cultivating international and high-quality maritime technical talents [1]. At present, with the steady expansion of enrollment scale in China's maritime vocational colleges and the increasing diversification of student sources, there exist significant individual differences among students in terms of English proficiency, learning habits and career development planning. The traditional homogenized teaching model featuring unified teaching goals, unified learning progress and unified evaluation criteria can no longer meet the personalized learning demands of students with different foundations and career orientations [2]. Meanwhile, the content of traditional Maritime English teaching is mostly centered on the theoretical knowledge in textbooks, lacking in-depth integration with real maritime job scenarios such as bridge communication, cargo operation and emergency response. This leads to the common prominent problem that students have solid basic English abilities but insufficient on-the-job application capabilities in practical maritime practice.

The rapid development and iterative upgrading of AI technology provide an effective technical solution for solving the above teaching dilemmas. Its core functions such as big data analysis, natural language processing and virtual simulation technology can realize the precise portrayal of students' learning characteristics, the personalized recommendation of Maritime English learning resources, and the dynamic monitoring and scientific regulation of the whole learning process [3]. In recent years, domestic and foreign research on the application of intelligent technology in vocational education has been continuously deepened, but the

targeted research focusing on the field of Maritime English teaching still has obvious deficiencies and research gaps: most studies are limited to the single application of intelligent assessment tools and auxiliary teaching software, lacking the systematic and in-depth construction of the personalized learning system; some studies mention the preliminary ideas of personalized teaching, but fail to combine the professional particularities of maritime positions to form an operable and implementable practical path, resulting in a serious disconnection between technological empowerment and actual teaching practice [4].

Based on the above research background and practical teaching pain points, this study takes precise matching of students' individual learning needs and in-depth alignment with maritime professional job standards as the core goals, constructs an AI-driven personalized Maritime English learning system, explores a scientifically feasible and step-by-step practical path, and verifies its actual application effect through empirical research. It is expected to provide original theoretical support and practical reference for the teaching reform and high-quality development of Maritime English in higher vocational colleges.

2. Core Characteristics and Practical Dilemmas of Personalized Learning in Maritime English

Personalized learning in Maritime English is not a simple hierarchical teaching based on academic performance, but a student-centered teaching model rooted in the individual characteristics of students and oriented by the actual needs of maritime jobs. It relies on the precise matching of learning resources and the dynamic optimization of learning strategies to realize the coordinated development and improvement of students' language application ability, maritime vocational skill and personalized development potential [5]. Its core characteristics can be summarized into three interrelated dimensions: first, demand precision, which requires accurate

matching with students' English basic level, learning style preferences and career development tendencies to avoid blind and homogeneous learning; second, scenario adaptability, which demands that the teaching content be deeply integrated into real maritime job scenarios to realize the seamless connection between knowledge learning and on-the-job application; third, process dynamics, which requires real-time adjustment and optimization of learning plans according to students' real-time learning progress and knowledge mastery, so as to ensure the continuous improvement of learning effects.

Combined with the teaching survey data of multiple maritime vocational colleges in China (the survey covers 12 maritime-related professional classes in 5 colleges, with 486 valid questionnaires recovered after screening), the current Maritime English teaching practice in higher vocational colleges mainly faces three prominent practical dilemmas: First, the lack of a scientific and effective personalized demand identification mechanism. 78% of the surveyed students believe that the existing teaching content does not match their own English foundation, and 32% of students with weak foundations have produced obvious learning weariness because they cannot keep up with the unified teaching progress. Second, the insufficient in-depth integration of teaching content and maritime job scenarios. 65% of the students report a serious disconnection between the Maritime English knowledge learned in class and the actual maritime internship scenarios, and 47% of the students have problems such as incorrect professional terminology usage and non-standard English expression in the simulated bridge communication practice. Third, the evaluation and feedback mechanism is single and rigid. 83% of the students hold the view that the existing evaluation methods overemphasize the results of summative examinations, ignore the comprehensive assessment of the whole learning process and practical application abilities, and make it difficult for students to obtain targeted and actionable improvement suggestions [6]. These practical dilemmas have directly restricted the improvement of Maritime English teaching quality and the cultivation of students' on-the-job application capabilities, and it is urgent to construct a scientific and systematic personalized learning system with the support of intelligent technology to solve them.

3. Original Construction of the AI-Driven Personalized Learning System for Maritime English

Combining the current teaching situation of Maritime English and the characteristic demands of personalized learning, this study adheres to the four core construction principles of demand orientation, job adaptation, technical support and dynamic optimization, and constructs a four-dimensional integrated personalized learning system consisting of intelligent diagnosis module, resource adaptation module, process regulation module and evaluation feedback module. Each module is interrelated, mutually supportive and progressive, forming a complete and closed-loop teaching system of "diagnosis-resource-regulation-evaluation". The specific system architecture and functional design are as follows:

(1) Intelligent Diagnosis Module: Constructing Three-Dimensional Student Portraits

Intelligent diagnosis is the logical starting point and

foundational link of personalized learning, whose core goal is to accurately construct a three-dimensional student portrait with the dimension of basic characteristics-learning characteristics-job needs through multi-dimensional data collection and systematic data analysis. This study designs an original and targeted diagnostic index system for maritime majors: the basic characteristics dimension covers 6 core indicators including entrance English test scores, mastery of basic maritime professional terminology and English grammar application ability; the learning characteristics dimension includes 5 key indicators such as learning rhythm preferences, resource reception habits (audio/video/text) and autonomous learning ability; the job needs dimension covers 4 core indicators such as career development planning (deck/engine direction), professional job skill priorities and the goal of obtaining maritime competency certificates [7].

Relying on the self-developed AI intelligent diagnosis system, the module integrates multi-source heterogeneous information such as students' entrance test results, daily homework completion, classroom interaction behavior data and career planning questionnaires. Through big data mining and analysis algorithms, it generates a personalized three-dimensional portrait report for each student, which clearly defines the students' learning strengths, weak knowledge links and professional job adaptation directions. For example, for a student with the characteristics of weak basic English, preference for video learning resources and clear planning of engaging in deck work, the portrait report will clearly point out the personalized learning needs such as "needing to strengthen the accumulation of basic maritime professional terminology and prioritize the recommendation of video learning resources for bridge communication scenarios".

(2) Resource Adaptation Module: Building a Three-Level Maritime English Resource Library

Based on the three-dimensional student portrait, the module constructs an original three-level hierarchical Maritime English resource library of Foundation Consolidation-Ability Improvement-Job Combat to realize the precise and dynamic matching between learning resources and students' individual needs. The resource library adopts a tripartite collaborative construction and update model of Maritime English teachers + maritime professional teachers + technical R&D personnel, which effectively ensures the linguistic standardization, professional accuracy and technical adaptability of the resource content:

Foundation Consolidation Layer: Focus on cultivating students' core basic Maritime English abilities, including basic maritime professional terminology manuals, grammar special reinforcement exercises and basic sentence pattern application templates. It is mainly suitable for students with weak English foundations to help them build solid core language application capabilities.

Ability Improvement Layer: Focus on training students' comprehensive Maritime English application abilities, including Maritime English reading skill guidance, professional document writing templates (e.g., deck logs, cargo operation documents) and listening comprehension special training materials. It is suitable for students with intermediate English foundations and certain basic maritime professional knowledge.

Job Combat Layer: Deeply restore and replicate real maritime job scenarios, including virtual simulation resources for bridge VHF communication, English dialogue cases for actual cargo operations and English expression scripts for

maritime emergency response. Among them, the virtual simulation resources can restore the real maritime operation scenarios through VR technology, allowing students to carry out immersive language application practice. This layer is suitable for students with solid basic abilities and clear career development directions [8].

At the same time, with the support of the intelligent recommendation algorithm of the AI platform, the module realizes the dynamic and precise push of learning resources: students with weak foundations will receive the learning resources of the Foundation Consolidation Layer first, and the system will automatically unlock the resources of the Ability Improvement Layer after they complete the preset learning goals and pass the assessment; students inclined to deck positions will be mainly pushed resources related to bridge communication and navigational warning interpretation; students inclined to engine positions will be focused on pushing targeted learning resources such as engine room equipment terminology and fault handling English expressions.

(3) Process Regulation Module: Building a Whole-Process Dynamic Guidance System

The process regulation module is the core link to ensure the effectiveness of personalized learning. It prevents the learning process from deviating from the preset goals by real-time tracking of students' whole-process learning data and dynamic scientific adjustment of learning strategies. Relying on the AI intelligent guidance platform, this module realizes three core functions of the whole learning process regulation: First, real-time dynamic monitoring of learning progress. It collects and analyzes students' learning data such as resource learning duration, practice accuracy rate and classroom interaction participation in real time. When a student's practice accuracy rate is lower than 60% for three consecutive times, the system will automatically suspend the current resource push and simultaneously push targeted supplementary learning materials for weak links. Second, intelligent triggering of hierarchical personalized tutoring. When multiple students encounter the same or similar learning problems (such as collective errors in the application of certain maritime professional terminology), the system will automatically remind teachers to carry out centralized targeted tutoring; when individual students have personalized learning problems (such as shaky mastery of specific sentence patterns), the system will precisely push one-on-one personalized tutoring resources. Third, automatic optimization of personalized learning plans. Based on the analysis of students' real-time learning progress and knowledge mastery, the system automatically generates weekly personalized learning plan adjustment suggestions, providing scientific decision-making references for both students and teachers [9].

(4) Evaluation Feedback Module: Constructing a Multi-dimensional Diversified Evaluation System

Breaking through the traditional single evaluation model that overemphasizes summative examination results, the module constructs a trinity diversified evaluation system of process evaluation + job practice evaluation + summative evaluation, with the weight distribution of 60%, 20% and 20% respectively. Process evaluation relies on the AI intelligent platform to automatically collect and quantify students' whole-process learning data, covering core evaluation indicators such as learning resource completion rate, practice accuracy rate and classroom interaction participation; job

practice evaluation focuses on assessing students' Maritime English application abilities in real scenarios through virtual simulation scenario operation, real maritime case analysis and other methods; summative evaluation adopts the combined model of basic knowledge test + comprehensive job scenario application test to comprehensively assess students' basic English language abilities and professional on-the-job application capabilities [10].

At the same time, with the support of AI data analysis technology, the module generates a detailed personalized evaluation report for each student, which clearly presents the students' learning strengths, existing deficiencies and weak knowledge links, and synchronously pushes targeted and actionable improvement suggestions and supplementary learning resources. For example, for a student with the problem of non-standard expression in bridge communication, the report will clearly sort out the specific types of errors (such as professional terminology misuse, non-standard sentence structure) and simultaneously push relevant virtual simulation practice resources and standard expression templates for targeted improvement.

4. Practical Path of AI-Driven Personalized Learning in Maritime English

Based on the above four-dimensional integrated personalized learning system, this study designs a four-stage progressive closed-loop practical path in combination with the teaching characteristics and professional laws of Maritime English, to ensure the effective implementation and landing of the system in actual teaching practice. The specific phased implementation process and key operation points are as follows:

(1) Phase 1: Intelligent Diagnosis and Portrait Construction (Weeks 1-2)

Organize students to complete the standardized entrance Maritime English basic ability test, learning style preference questionnaire and career development planning interview in a unified manner. The AI intelligent diagnosis system is used to collect, collate and analyze the above multi-source data to generate an initial three-dimensional student portrait report for each student. On this basis, teachers combine the overall learning situation of the class and the individual characteristics of students to calibrate, optimize and improve the portrait report, and further clarify the hierarchical personalized learning goals for students with different foundations: students with weak foundations take consolidating basic Maritime English terminology and core application sentence patterns as the core goal; students with intermediate foundations focus on improving comprehensive Maritime English application abilities; students with good foundations take mastering professional on-the-job scenario English application skills as the key goal.

(2) Phase 2: Personalized Resource Push and Autonomous Learning (Weeks 3-12)

The AI intelligent platform pushes personalized and hierarchical learning resources for each student according to the calibrated three-dimensional student portrait, and students carry out autonomous and personalized learning according to their own learning rhythm and habits. Teachers monitor the real-time learning data of students through the platform, and carry out hierarchical targeted teaching guidance: for the common learning problems existing in most students (such as

collective misunderstandings of certain maritime document terminology), organize 1-2 centralized explanation and tutoring sessions; for the personalized learning problems of individual students, provide targeted support through online Q&A, one-on-one tutoring and other forms. For example, students who prefer video learning resources are pushed bridge communication scenario videos with supporting interactive practice exercises; students who prefer text learning resources are pushed deck log writing templates and typical case analysis materials.

At the same time, the platform carries out a weekly intelligent learning review for each student: it automatically analyzes the students' weekly learning data, identifies the learning weak links and dynamically adjusts the priority of subsequent resource push; students combine their own learning experience and teachers' guidance suggestions to optimize and adjust their autonomous learning plans, so as to ensure that the whole learning process always fits their individual personalized learning needs.

(3) Phase 3: Job Scenario Simulation Practice (Weeks 13-16)

Focusing on the core typical scenarios of maritime jobs, organize students to carry out immersive virtual simulation practice and group cooperative learning. With the help of the VR virtual simulation system, the real maritime working scenarios such as bridge berthing/departure communication, cargo document verification and maritime emergency response are restored, allowing students to carry out immersive Maritime English application practice, and the system provides real-time feedback and correction on the problems of students' expression standardization and terminology accuracy in the practice process. Students are grouped according to the principles of complementary learning foundations and similar career development directions, with 5-6 students in each group. Around the typical cases of Maritime scenario English communication, carry out group discussions, role-playing and other learning activities, and teachers provide the whole process of guidance and comment, so as to simultaneously improve students' scenario English application abilities and team cooperation abilities [11].

(4) Phase 4: Diversified Evaluation and System Scheme Optimization (Weeks 17-18)

Complete the data collection and quantitative analysis of the trinity diversified evaluation, and the AI intelligent platform generates a detailed personalized learning evaluation report for each student. Combine teacher evaluation and student self-evaluation to comprehensively sort out and clarify the students' learning effectiveness, existing problems and future improvement directions; for the common and individual problems found in the evaluation, the system pushes targeted special reinforcement learning resources for students and helps them formulate follow-up learning plans. At the same time, the research team and teaching team summarize the experience and existing deficiencies in the implementation process of the practical path, optimize and improve the content of the three-level resource library and the functional modules of the AI intelligent platform, forming a complete closed-loop of intelligent diagnosis-personalized learning-scenario practice-diversified evaluation-system optimization for personalized Maritime English learning.

5. Empirical Research and Effect Analysis

(1) Research Design

Research Objects: Four classes of 2024-grade Maritime Technology major in Jiangsu Maritime Institute were selected as the research objects, which were randomly divided into the experimental group and the control group. The experimental group (2 classes, 92 students) adopted the AI-driven personalized learning system and practical path constructed in this study for teaching; the control group (2 classes, 90 students) adopted the traditional homogenized teaching model. Through the pre-test of Maritime English and the learning interest questionnaire survey, the independent sample t-test was conducted, and the results showed that there were no significant differences between the two groups in terms of English basic ability, learning interest and career planning ($P>0.05$), which ensured the comparability of the two groups.

Research Cycle: One semester (18 weeks), consistent with the normal teaching schedule of Maritime English.

Data Collection: Three types of data were collected in this study: ① Learning behavior data, including resource completion rate, weekly learning duration and practice accuracy rate, collected through the AI intelligent platform; ② Academic performance data, including the scores of Maritime English pre-test and post-test (basic knowledge test and job scenario application test); ③ Subjective feedback data, collected through teacher and student questionnaires and in-depth semi-structured interviews.

Data Processing: The collected data were sorted and screened, and the statistical software SPSS 26.0 was used for descriptive statistical analysis and independent sample t-test to verify the statistical significance of the research results.

(2) Research Results

Remarkable Improvement in Comprehensive Learning Effectiveness: After the 18-week teaching experiment, the comprehensive average score of Maritime English in the experimental group was 82.6 points, while that in the control group was 73.9 points, with an average increase of 8.7 points. The independent sample t-test showed that the difference between the two groups was statistically significant ($P<0.01$). In the professional job scenario application test, the pass rate of the experimental group reached 93%, while that of the control group was only 75%, an increase of 18 percentage points. Among them, the improvement of students' English application abilities in typical maritime scenarios such as bridge communication and emergency response was the most prominent.

Significant Enhancement in Students' Learning Engagement: The learning behavior data collected by the AI intelligent platform showed that the average weekly learning duration of students in the experimental group was 5.2 hours, an increase of 2.5 hours compared with the control group (2.7 hours); the overall completion rate of personalized learning resources reached 95%, an increase of 23 percentage points compared with the control group (72%); the number of active classroom interactions of students in the experimental group increased by 67% compared with the control group, showing a significant improvement in students' autonomous learning initiative and learning engagement.

Positive Subjective Feedback from Teachers and Students: The questionnaire survey results showed that 89% of the students in the experimental group believed that the

personalized learning resources pushed by the system were highly matched with their own learning needs; 85% of the students stated that their Maritime English application ability in real professional scenarios had been significantly improved after the experiment. In the teacher interview, 84% of the teachers believed that the AI-driven personalized learning system effectively reduced the workload of teachers' personalized tutoring, and significantly improved the overall teaching efficiency and teaching effect [12].

(3) Discussion of Results

The empirical research results show that the AI-driven personalized Maritime English learning system and four-stage closed-loop practical path constructed in this study have significant application effects in actual teaching practice, and can effectively solve the core pain points of traditional Maritime English teaching. Its core advantages are mainly reflected in three aspects: First, the three-dimensional student portrait constructed based on multi-source data realizes the precise identification and mining of students' personalized learning needs, effectively solving the core teaching problem of "what to teach to better fit the individual needs of students". Second, the three-level hierarchical resource library deeply integrated with maritime job scenarios realizes the precise matching of learning resources and professional job needs, solving the realistic dilemma of "disconnection between knowledge learning and on-the-job application" in traditional teaching. Third, the whole-process dynamic regulation mechanism and the trinity diversified evaluation system realize the precise control and scientific evaluation of the personalized learning process, effectively improving the implementation effectiveness of personalized teaching and the quality of learning feedback.

At the same time, in the process of empirical research, this study also found some existing deficiencies and areas for improvement that need to be optimized: First, the interactivity and operation simplicity of the VR virtual simulation scenarios on the AI intelligent platform need to be further improved; some students reflected that the operation process of individual scenario simulation is relatively complex, which affects the immersive learning experience. Second, the Maritime English learning resources adapted to the latest international maritime conventions and industry standards in the three-level resource library are relatively insufficient, and the resource update mechanism needs to be further improved and optimized. Third, a small number of students with weak foundations and low digital literacy adapt slowly to the operation of the AI intelligent platform; the initial guidance and systematic operation training for students need to be further strengthened in the follow-up teaching.

6. Conclusion

Aiming at the prominent core pain points in Maritime English teaching of higher vocational colleges, such as the huge individual gap in students' basic abilities, the serious disconnection between teaching content and maritime job needs, and the lack of targeted personalized guidance, this study takes the integration of AI technology and maritime vocational education as the technical support, constructs a four-dimensional integrated AI-driven personalized Maritime English learning system including intelligent diagnosis, resource adaptation, process regulation and evaluation feedback modules, and designs a four-stage progressive closed-loop practical path of portrait construction-personalized autonomous learning-job scenario simulation

practice-diversified evaluation and system optimization. Empirical research results show that the implementation of this system and path can realize the precise matching of students' individual learning needs and maritime professional job needs, significantly improve students' comprehensive learning effectiveness of Maritime English, professional scenario application abilities and autonomous learning engagement, and effectively solve the multiple dilemmas of traditional homogenized teaching.

The three-dimensional student portrait index system, the three-level job-adapted hierarchical resource library and the four-stage closed-loop practical path proposed in this study have realized the organic integration of intelligent technological empowerment and Maritime English teaching practice, breaking the research bottleneck of the single application of intelligent technology in the field of Maritime English teaching. The research results provide an operable and original practical scheme for the personalized teaching reform of Maritime English in higher vocational colleges, and further enrich the research vision and practical exploration of intelligent technology empowering the high-quality development of vocational foreign language education.

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