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Digital Intelligence and Industry-Education Collaboration in Higher Vocational Civil Aviation Foreign Language Education

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Abstract: This study takes the world-class airport cluster in the Guangdong–Hong Kong–Macao Greater Bay Area as its research context and aims to construct a job-based foreign language competency framework covering multiple civil aviation job groups. On this basis, it proposes an industry-education collaborative operating mechanism and integrates curriculum-based ideological and political education into digital intelligence teaching activities. A 16-week quasi-experiment was conducted with 84 students to test the effectiveness of this educational pathway. The results showed that the experimental group performed better than the control group with respect to accuracy and mastery of core civil aviation broadcast expressions, with statistically significant differences and large effect sizes. These preliminary findings indicate that learners' pragmatic competence in civil aviation-related scenarios has been greatly improved by adopting the proposed pathway. The study offers practical references for higher vocational colleges to cultivate compound foreign language talents for the civil aviation industry.

Keywords: Digital intelligence empowerment; Industryeducation collaboration; Civil aviation English; English for Specific Purposes (ESP)

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1. Introduction

In 2026, the first year of China's 15th Five-Year Plan, a national medium-long-term socioeconomic development blueprint, artificial intelligence, virtual reality, and other digital technologies are profoundly reshaping the talent-training logic of vocational education. Lu [1] stressed that four technologies—large language AI models, digital twins, edge computing, and embodied intelligence—should be embedded into vocational education to reshape skill structures and advance the integration of high-level engineering-oriented foreign language competence with digital intelligence technologies.

Civil aviation is a highly internationalized industry, in which the quality of English communication is tightly linked to aviation safety. Aviation staff often face communicative barriers in realworld work contexts. Typical problems include struggling with technical vocabulary acquisition, accent comprehension, and high-stress communication [2]. Civil aviation frontline roles ranging from cabin crew and groundservice staff to aviationmaintenance technicians demand roletailored English competence for cabin announcements, onsite passenger interactions, and technicalmanual comprehension. Crosscultural awareness is also essential for delivering services to diverse international travelers [3,4].

Current higher vocational civil aviation foreign language teaching is confronted with three prominent contradictions. First, teaching materials and content tend to be generic or outdated, lacking authentic professional scenarios and terminology specific to civil aviation operations. As Wang [5] noted, there is a significant gap between what is taught in the classroom and what is required in real-world aviation workplaces. Second, teaching practice is poorly integrated with digital intelligence technologies. Third, school-enterprise cooperation remains superficial and largely limited to student internships. Deep collaboration in curriculum development, competency-standard co-construction, and joint development of teaching resources has not been fully realized among higher vocational civil aviation colleges [6,7].

The integration of Artificial Intelligence (AI) into vocational English teaching has revolutionized educational practices, offering personalized learning experiences and enhanced language acquisition. Chen [8]analyzed the advantages of applying generative AI to college English teaching in terms of teaching model innovation, differentiated instruction, and students' autonomous learning, and constructed a generative AI-based human-machine collaborative teaching model for college English. Sun [9]constructed an inquiry-based teaching model featuring triadic "teacher–student–machine" collaboration. Hu [10]explored the issues associated with AI technology in vocational English teaching and proposed strategies to overcome these challenges posed by AI technology. In the research on industry-education integration and regional development, Zhu [11]put forward a curriculum ideological and political system of "one alignment and two integrations," stressing the enhancement of the relevance between students' learning and their future jobs. Yan [12]pointed out that it is necessary to adhere to the value leadership of Marxism, build a teaching model of virtual-real symbiosis and human-machine synergy, and make concerted efforts by the government, schools, technology providers, and other parties to build a digital wisdom vocational undergraduate Civics ecology.

Nevertheless, existing research remains fragmented. Most studies focus on graded instruction, competency-requirement analysis, or isolated technical applications. Hardly any research constructs a holistic foreign language education pathway that combines digital intelligence empowerment with industry-education collaboration for higher vocational civil aviation majors. This gap highlights the necessity of the present study.

Guided by ESP demand-analysis theory, this research selects civil aviation enterprises and higher vocational institutes in the Greater Bay Area as research objects. This paper constructs a job-based foreign language competency framework, designs digital intelligence-driven whole-process teaching procedures, innovates industry-education collaborative governance mechanisms, and integrates curriculum-based ideological and political education into digital teaching scenarios. It intends to provide replicable solutions for vocational foreign language reform responding to civil aviation industrial demands.

2. Theoretical framework

English for Specific Purposes (ESP) demand analysis serves as the core theoretical foundation of this research [13,14]. Rooted in target-situation analysis, ESP teaching advocates designing teaching objectives, content, and assessment schemes according to learners' linguistic needs in future occupational scenarios. Within civil aviation vocational contexts, demand analysis covers objective job requirements raised by aviation enterprises as well as subjective learning needs of higher vocational students [15]. This study collects first-hand data on linguistic tasks in real civil aviation posts, translates industrial competency requirements into deliverable curriculum indicators, and narrows the supply-demand gap between foreign language talent output from vocational colleges and talent expectations of enterprises.

Digital intelligence empowerment acts as the technical instrument; industry-education collaboration provides institutional guarantee; curriculum-based ideological and political education delivers value guidance throughout talent cultivation. The complete logical chain runs as follows: "construction of job-based competency framework → design of digital intelligence teaching pathway → innovation of industry-education collaborative mechanisms → value-oriented integration of ideological and political education."

3. Research methodology

Mixed research methods combining questionnaire surveys, semistructured interviews and action research were adopted for this study.

Questionnaires were distributed to frontline civil aviation practitioners and higher vocational students from more than six major civil aviation enterprises, covering three core job groups: cabin crew, ground service, and aviation maintenance. After pre-investigation for revision, 150 valid questionnaires were collected, with satisfactory reliability (Cronbach's $\alpha = 0.82$). More than 20 semi-structured in-depth interviews were conducted, including 8 enterprise trainers, 6 department supervisors, and 6 vocational college teachers. Questionnaire items focused on the real-world frequency of English tasks, perceived competency deficiencies, and expectations for college-trained graduates. Interview themes included job-specific English challenges, curriculum-reform suggestions, and application prospects of digital intelligence tools in workplace settings.

Quasi-experimental action research was implemented. Two intact natural classes with comparable pretest English proficiency were chosen as the experimental group and the control group, with 42 participants in each group.

4. Research findings and pathway construction

4.1. Construction of a civil aviation job-based foreign language competency framework

This study establishes a three-dimensional civil aviation foreign language competency framework, consisting of linguistic skills, vocational situational competence, and cross-cultural communicative literacy.

Competency indicators draw on core requirements of ICAO language proficiency standards while appropriately lowering threshold expectations to match the talent-training positioning of higher vocational education.

4.2. Whole-process teaching design empowered by digital intelligence technology

This research integrates generative artificial intelligence, speech-recognition evaluation, and blockchain-supported learning trace storage into the full "teaching-learning-practice-testing-assessment" workflow.

First, AI-driven personalized learning paths are generated to address prominent individual differences among vocational students. Based on pre-test results, learning-platform behavioral data, and weakness diagnosis, the system pushes adaptive civil aviation English learning modules.

Second, intelligent speech evaluation delivers instant multidimensional feedback. Beyond phonetic accuracy scoring, the system identifies highrisk pragmatic features in simulated aviation emergency utterances, such as unnatural pauses, frequent selfrepair, and ambiguous instruction expressions that may threaten aviation safety.

Third, immersive simulation practice provides authentic highrisk scenario resources hard to obtain in traditional classrooms. Learners complete interactive oral tasks within virtual contexts such as passenger disputes triggered by flight delays and in-flight equipment failures. Repeated situational drills can be completed without facing realworld aviation risks.

Finally, learning trace storage visualizes students' holistic growth trajectories. Online exercises, simulation performance, and evaluation feedback from enterprise mentors are securely stored, supplying references for comprehensive assessment and post-employment competency screening.

4.3. Innovation of the industryeducation collaborative operating mechanism

To deal with superficial school and enterprise cooperation, this study builds an indepth collaboration mechanism featuring "joint formulation of standards, joint development of curricula, joint sharing of teaching staff, and joint construction of resources."

First, representatives from airport groups and airlines participate in revising job-based foreign language competency standards and designing modular curricula under the "curriculum-post-certificate-competition" framework. Real enterprise work tasks, typical service cases, and internal training materials are transformed into teaching resources for higher vocational colleges.

Second, an industry-education integration community is constructed. Frontline enterprise trainers work as part-time teachers delivering scenario-oriented oral classes. Meanwhile, college teachers take temporary posts in aviation enterprises to update their understanding of industrial practices.

Third, assessment subjects are diversified. Evaluation of students' civil aviation English competence combines scoring from classroom teachers, output from intelligent platforms, and feedback provided by enterprise mentors during internships. In this way, assessment results can genuinely reflect students' job-adaptation capacity.

4.4. Embedding curriculum-based ideological and political education into digital intelligence teaching

Value guidance should not be separated from digital teaching activities. This study systematically integrates the aviation spirit of "safety priority, rigorous attitude, service supremacy," craftsmanship, global vision and patriotism into digital intelligence teaching links. In simulation scenarios, teachers guide students to recognize safety responsibilities behind standard English radiotelephony expressions. Typical service cases of Chinese civil aviation practitioners serving international passengers are embedded within digital-resource libraries, helping students perceive professional accountability and awareness of national image embedded in

foreign language service behaviors. Ideological-political elements are no longer isolated fragmented lectures but naturally integrated into language-skill training tasks. It should be acknowledged that this research only completes instructional design for ideological-political education; quantitative measurement of its educational effect is not covered and awaits follow-up research.

4.5. Preliminary experimental results

After the 16week teaching intervention, descriptive statistics and independent samples *t*tests were performed for both groups ($n = 42$ per group). In pronunciation accuracy, the experimental group reached M = 82.34 (SD = 5.71), and the control group obtained M = 74.68 (SD = 6.23). The intergroup difference was statistically significant: $t(82) = 5.81$, $P < 0.001$, Cohen's $d = 0.85$, representing a large effect size. For mastery rate of core civil aviation broadcast expressions, the experimental group scored M = 79.52 (SD = 6.48), versus M = 71.17 (SD = 7.02) for the control group; $t(82) = 5.24$, $P < 0.001$, Cohen's $d = 0.78$.

Learning platform log data show that the experimental group achieved an average weekly effective learning duration of 41.6 minutes, compared with 26.3 minutes for the control group. Postclass semistructured interviews with 12 randomly selected participants from the experimental group reveal that most students experienced reduced oralpractice anxiety thanks to instant AIgenerated feedback.

5. Discussion

Against the backdrop of digital intelligence transformation, this study constructs a systematic foreign language talent-cultivation pathway for higher vocational civil aviation majors. Unlike existing research that focuses merely on technical application or competency analysis for a single post, this paper combines technical empowerment, institutional guarantee from industry-education collaboration, and value guidance from curriculum-based ideological and political education throughout the whole talent-cultivation procedure.

This research carries distinct regional relevance. Targeting world-class airport clusters in the Guangdong-Hong Kong-Macao Greater Bay Area, it adopts authentic case resources from local aviation enterprises, avoiding mismatches between imported theoretical models and domestic vocational-college realities. Meanwhile, the overall framework enjoys extensibility. With moderate adjustments to job-competency indicators, the research framework can be transferred to other vocational education fields requiring intensive international language services.

Several limitations deserve attention. First, samples of enterprises and colleges are confined to the Guangdong-Hong Kong-Macao Greater Bay Area. Future research should expand sampling scope to test model applicability across other regions in China. Second, digital intelligence teaching depends heavily on hardware and infrastructure conditions of vocational colleges. Simplified implementation schemes are needed for institutions with insufficient digital facilities. Third, the quasi-experiment only lasted 16 weeks. Long-term follow-up research is required to verify whether competency improvement can be steadily transferred to real-world job performance after graduation. Fourth, the present study does not implement quantitative evaluation for curriculum-based ideological-political education outcomes.

From the perspective of secondlanguage acquisition, instant, lowanxiety feedback brought by AI tools partly explains the better performance of the experimental group. AIassisted drills lower learners' fear of negative evaluation in oral practice, which helps increase learning engagement and consolidate pragmatic competence.

For foreign language educators in higher vocational colleges, this research has the following implications. First, vocational foreign language reform must be rooted in industrial job demands rather than simply copying general-English teaching logic. Demand investigation targeting real-world occupational posts serves as the prerequisite for curriculum optimization. Second, digital intelligence technologies should serve talent-cultivation objectives instead of becoming superficial demonstrative tools. The core value of AI lies in solving practical teaching pain points such as insufficient authentic practice contexts and lack of personalized instant feedback. Third, deep industry-education collaboration cannot be limited to internship arrangements. Enterprises ought to participate in standard formulation, curriculum development, and multi-dimensional assessment. Joint governance between colleges and industry can narrow the gap between talent supply and enterprise expectations.

6. Conclusion

Responding to requirements set by the Civil Aviation Powerful Country Initiative and the Powerful Country in Education Strategy, higher vocational civil aviation foreign language education should cultivate compound talents equipped with linguistic competence, vocational job capacity, digital intelligence literacy and cross-cultural global vision. To tackle three core dilemmas—disconnection between learning and application, poor integration between teaching and digital intelligence technologies, and superficial school-enterprise cooperation—this study takes the civil aviation industrial cluster of the Guangdong-Hong Kong-Macao Greater Bay Area as its research field. Supported by ESP demand-analysis theory, this paper builds a three-dimensional job-based foreign language competency framework for civil aviation, designs whole-process teaching workflows empowered by AI speech evaluation and immersive simulation, innovates deep industry-education collaboration mechanisms, and embeds aviation-spirit-related ideological-political elements into digital teaching scenarios. Experimental teaching evidence demonstrates that this pathway can effectively enhance students' pragmatic competence in civil aviation scenarios and raise their learning engagement.

This study offers a complete and actionable solution for higher vocational civil aviation foreign language teaching reform. In follow-up work, the research team will further expand investigation samples, enrich digital intelligence teaching resource banks, conduct long-term tracking of graduates' job-adaptation status, and continuously improve this replicable educational pathway. It is expected to provide practical references for vocational foreign language innovation-oriented national industrial strategies.

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Disclosure statement

The author declares no conflict of interest.

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