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Optimization and Exploration of Practical Teaching for Computer-Related Majors Based on the Concept of Cross-Integration

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Abstract: Amid the rapid development of the digital economy, industrial digital transformation keeps deepening, and computer technologies are more closely integrated with fields such as artificial intelligence and big data. Society has an increasingly urgent demand for compound and innovative technical-skilled talents majoring in computer-related disciplines. The traditional practical-teaching mode for computer-related major groups has prominent professional barriers and outdated teaching content, which can hardly meet the talent-cultivation requirements of industries in the new era. Guided by the concept of cross-integration and based on the actual teaching conditions of computer-related major groups in colleges and universities, this paper systematically analyzes major existing problems in practical teaching, puts forward optimization paths for practical teaching of computer-related major groups, and constructs a multi-dimensional, cross-field and integrated cross-integration practical-teaching system. It aims to improve students' cross-field practical capabilities and innovative thinking, and provide theoretical references and practical experience for practical-teaching reform and talent-cultivation quality improvement of computer-related major groups in institutions of higher education.

Keywords: Concept of cross-integration; Computer-related major groups; Practical teaching

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1. Introduction

The concept of cross-integration serves as one of the important guiding ideologies for higher-education teaching reform in the new era. Its essence is to break boundary barriers among disciplines, majors, courses and industries, and realize in-depth integration of knowledge, technologies, resources and scenarios. It conforms to the development trend of cross-border integration of digital industries and the cultivation demands for compound talents. Against such a background, promoting the in-depth integration of the cross-integration concept into practical teaching of computer-related major groups, reconstructing practical-teaching systems, innovating teaching modes and improving teaching resources has become an inevitable trend for solving current teaching dilemmas, enhancing talent-cultivation quality and meeting industrial development requirements. Based on teaching practices of computer-related majors in colleges and universities, this paper

comprehensively analyzes existing problems in practical teaching, explores improvement measures for practical teaching under the cross-integration concept, and attempts to build a new practical-teaching system for computer-related majors adapted to the development needs of digital industries in the new era, so as to offer practical support for teaching reform of computer majors in colleges and universities.

2. Problems existing in practical teaching of computer-related major groups

2.1. Solidified professional barriers

At present, most colleges and universities adopt the teaching mode of "independent talent cultivation for separate majors" for computer-related major groups. Talent-cultivation schemes, curriculum systems and practical links of each major are independent of one another. Effective connection and integration among majors are insufficient, which solidifies professional barriers and becomes a major bottleneck restricting the improvement of students' comprehensive capabilities [1]. In terms of curriculum setup, practical courses for majors such as Computer Science and Technology, Software Engineering, Network Engineering, and Big-Data Technology operate separately, with little overlap in course content and serious gaps in content connection [2]. The Network Engineering major focuses on network construction, operation, and maintenance training, lacking practical content in big-data analysis and artificial-intelligence applications. The Big-Data Technology major centers on data mining and data-processing training, without hands-on practice of network architecture and system development.

In terms of practical-teaching implementation forms, practical links including course training, course design, innovation-and-entrepreneurship competitions and graduation projects are carried out on the basis of a single major. Comprehensive cross-major and cross-field practical projects are rare [3]. Long-term exposure to the knowledge system and practical environment of their own major results in students' narrow knowledge horizons. They cannot form multi-angle technical thinking or master capabilities for integrated application of multiple technologies [4]. Real-world engineering projects in enterprises nowadays feature multi-technology integration. For instance, the construction of smart campuses, intelligent-manufacturing systems and smart-city platforms requires the simultaneous adoption of network technologies, software development, big-data analysis, intelligent algorithms and other technologies. Job positions cannot be fulfilled merely with skills from a single major, which leads to disconnection between talent cultivation and industrial demands [5].

2.2. Lagging practical-teaching contents

Fast iteration and short update cycles of information technologies are characteristics of the computer industry. Nevertheless, the update speed of practical-teaching contents for computer-related major groups in colleges and universities lags far behind industrial technological development, showing obsolescence [6]. On the one hand, practical-teaching contents in most colleges and universities still focus on traditional basic technologies. Outdated training projects are continuously adopted, while cutting-edge technologies such as artificial intelligence, large-model applications, cloud-native development, and Internet-of-Things edge computing are seldom covered. Some training content remains at basic stages, including elementary coding, simple network setup, and fundamental data processing, lacking comprehensive and cutting-edge training projects oriented toward real-world industrial scenarios [7].

On the other hand, practical textbooks and training resources are updated slowly. Most practical textbooks have not been revised for years and fail to adapt to mainstream industrial technical frameworks and industry

standards at present. Meanwhile, teaching content emphasizes practical verification of theoretical knowledge and training for individual knowledge points, lacking integration and cross-border fusion of knowledge points. Comprehensive practical content is not designed in combination with industrial application scenarios [8]. In addition, practical teaching in some colleges and universities relies excessively on textbooks and courseware. Teachers conduct training teaching following fixed procedures, and students finish training tasks mechanically. There are few opportunities for independent exploration and innovative design, making it impossible to cultivate practical capabilities adapted to new industrial technologies and scenarios [9].

2.3. Single-dimensional practical-teaching system

A complete practical-teaching system for computer-related majors shall contain four levels: basic training, comprehensive training, innovative training and engineering practice, so as to achieve progressive talent-cultivation effects. However, the practical-teaching-system structure in most colleges and universities is single-dimensional with ambiguous levels and insufficient integrated construction [10]. Practical-teaching links are highly fragmented. Course training, semester training, graduation training and innovation-and-entrepreneurship practice are disconnected. There is no systematic connection. Objectives of each practical link are inconsistent and contents are discontinuous, failing to form a complete training chain for practical capabilities [11].

Besides, practical-teaching levels are ambiguous. Contents of basic training for lower-grade students overlap with comprehensive training for higher-grade students. No gradient is formed among basic-skill training, comprehensive-ability cultivation and innovation-ability improvement. Lower-grade students only complete simple operational training without thinking-skill cultivation; higher-grade students lack difficult and comprehensive cross-field practical projects, so their capabilities cannot be further improved [12]. At the same time, practical teaching overemphasizes on-campus classroom training, while ignoring off-campus enterprise practice, project practice, innovation-and-entrepreneurship practice and other practical links. On-campus training is disconnected from real-world enterprise projects. Students cannot get access to real industrial engineering workflows, technical standards and post specifications, so their engineering-practice capabilities and professional literacy cannot be effectively enhanced.

3. Practice of integrating the concept of cross-integration into teaching of computer-related major groups

3.1. Break professional barriers and reconstruct cross-integrated curriculum-practice system

Guided by the cross-integration concept and based on industrial post demands and compound-talent-cultivation objectives, break barriers among various computer-related majors, integrate teaching resources of the major groups, and reconstruct a hierarchical curriculum-practice system of “interconnected basics, complementary cores, cross-disciplinary expansion and integrated practice”, realizing in-depth cross-integration of professional knowledge and technical capabilities. First of all, optimize public basic practical courses. Integrate general basic contents of computer-related major groups and offer cross-major general practical courses, namely general training courses such as Fundamentals of Computer Programming, Fundamentals of Data Processing, Fundamentals of Network Technology and Fundamentals of Intelligent Technology. Break basic-teaching barriers among majors, enabling students to master multi-major basic skills and form an

underlying cross-disciplinary knowledge structure [13].

Second, redesign core practical courses for each major, weaken boundaries of single-major courses, and promote cross-integration reform of core courses. For core courses of majors including Software Engineering, Network Engineering, Big Data and Artificial Intelligence, integrate overlapping contents and add cross-disciplinary contents to build cross-major integrated training modules [14]. Add big-data-analysis and intelligent-algorithm-application modules to Software-Engineering-major training; supplement software-development and system-architecture-construction training contents to Big-Data-major training; incorporate Internet-of-Things and cloud-platform-operation-and-maintenance practice contents into Network-Engineering training, so as to realize mutual complementarity of core skills for each major.

Third, add cross-major comprehensive practical courses. Set up comprehensive practical courses such as Smart-System Development, Intelligent Big-Data Application and Internet-of-Things-Platform Construction based on industrial integrated-application scenarios. Take real-world projects as carriers to integrate multiple professional-technical knowledge and guide students to realize integrated application of multiple technologies. Meanwhile, build a four-level practical-course system consisting of basic training, major-specific training, cross-major comprehensive training and innovation-and-entrepreneurship practice according to students' ability gradients, so as to gradually improve students' cross-disciplinary practical capabilities and thoroughly resolve problems of major segmentation and knowledge fragmentation.

3.2. Connect industrial cutting-edge developments and iterate practical-teaching contents

Centering on technical-development trends of the digital industry and post-competence requirements of enterprises, dynamically update practical-teaching contents oriented toward cross-integrated application. Eliminate outdated training projects, incorporate cutting-edge technologies, industrial scenarios and real-world cases to realize synchronization between teaching contents and industrial development. On the one hand, set up a teaching-content-research-and-development team composed of professional teachers, enterprise technical experts and industrial mentors. Keep track of industrial-technology trends and enterprise post-skill requirements, and renovate the training-project library in combination with emerging technologies including artificial intelligence, large models, cloud computing, Internet of Things and digital twins. Transform traditional single-skill training projects into comprehensive multi-technology-integrated training projects, highlight cross-border industrial-application scenarios, and build cross-disciplinary training cases for industries such as smart healthcare, smart transportation, intelligent manufacturing and digital culture-and-tourism.

On the other hand, promote in-depth connections between practical teaching content and industrial standards, as well as enterprise projects. Convert real-world enterprise engineering projects, technical cases and research-and-development workflows into teaching resources and integrate them into practical links including daily training, course design and graduation projects. Meanwhile, build a dynamically updated practical teaching resource library covering cutting-edge technology training tutorials, cross-major project cases, enterprise project source codes and industrial specifications, and update technical content in a timely manner to guarantee the cutting-edge nature, practicality, and cross-disciplinary features of teaching content. In addition, encourage teachers to take scientific-research projects and enterprise-cooperation projects as supports for developing featured cross-disciplinary training courses, and transform scientific-research achievements and new industrial technologies into teaching contents to broaden students' knowledge boundaries and practical horizons [15].

3.3. Innovate teaching modes and promote project-oriented cross-disciplinary practical teaching

To meet the requirements of the cross-integrated practical-teaching system, break traditional single-dimensional training-teaching modes and implement a new teaching mode of "cross-major team formation, project-driven instruction and scenario-oriented training". Take comprehensive cross-disciplinary projects as carriers to boost the improvement of students' cross-field practical capabilities. In teaching implementation, abandon the passive-training mode featuring teacher demonstration and student imitation. Adopt the combination of project-based teaching, case-based teaching and inquiry-oriented teaching for practical-teaching implementation driven by real-world cross-disciplinary application projects.

In accordance with the technical requirements of cross-disciplinary training projects, break the boundaries of classes and majors to form cross-major training groups, where students from different majors jointly complete the whole process of project research-and-development, design, and implementation. Take the comprehensive-training project of developing a smart-campus management system as an example: students majoring in Network Engineering finish network-architecture construction and syste m-operation-and-maintenance work; Software-Engineering students complete system programming and function realization; Big-Data-major students conduct campus-data collection, analysis and optimization; Artificial-Intelligence-major students are responsible for designing functions of intelligent identification and intelligent push. Students of various majors cooperate through division of labor and realize integrated application of multiple technologies.

Meanwhile, teachers no longer merely explain fixed procedures in training. Instead, they guide students to analyze project requirements, design technical schemes, and solve cross-disciplinary technical challenges on their own, so as to cultivate students' independent-innovation capabilities, cross-field problem-solving capabilities, and teamwork spirit. Furthermore, rely on the online-offline blended-teaching mode to build an online cross-disciplinary training platform, integrate multi-major training resources, and reserve spare time for students to complete independent cross-major training and project exploration after class, thus expanding the scope of practical teaching.

4. Conclusion

To sum up, applying the concept of cross-integration to practical teaching of computer-related major groups serves as an effective way to solve current practical-teaching difficulties and satisfy demands for compound talents in the digital industry. Breaking professional barriers to reconstruct practical systems, keeping pace with industrial cutting-edge developments to update teaching contents, and innovating project-oriented modes to carry out cross-disciplinary training can effectively improve students' capabilities in applying cross-major technologies and raise the quality of talent cultivation in computer-related major groups. In the future, further deepen industry-education integration, continuously improve cross-disciplinary practical projects in cooperation with enterprises, perfect the cross-major-training evaluation system, and keep exploring new paths and new modes for compound-talent cultivation of computer-related major groups, so as to cultivate more high-quality compound technical-skilled talents for the digital-economy sector.

Disclosure statement

The author declares no conflict of interest.

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