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System Reconstruction and Teaching Reform of "Learning by Doing" Internship Courses Under University-Enterprise Collaboration

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Abstract: In recent years, the university-enterprise collaborative education model has been continuously promoted and applied. The traditional internship curriculum system has become increasingly unable to meet the practical needs of applied talent cultivation. Based on the background of university-enterprise collaboration and taking "learning by doing" as the core concept, this paper explores the system reconstruction and teaching reform of internship courses. It aims to build a university-enterprise collaborative teaching framework, form a structured "dual-qualified" teaching team, optimize internship content and process evaluation systems, comprehensively cultivate students' practical application ability, innovative exploration ability and comprehensive professional literacy, and achieve precise matching between talent cultivation and industrial needs.

Keywords: University-enterprise collaboration; Learning by doing; Internship courses; System reconstruction; Teaching reform

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1. Introduction

With the deep integration and industry-education integration transformation of university-enterprise collaborative education in recent years, practical teaching has become the key to applied talent cultivation. The concept of "learning by doing" provides new ideas for internship curriculum reform. Internship courses are an important carrier connecting theoretical teaching and industrial practice. Therefore, the construction of an internship curriculum system should be based on actual industrial needs and talent cultivation goals. This paper uses the industry-university-research integration platform to conduct research on system reconstruction and teaching reform of "learning by doing" internship courses under university-enterprise collaboration, and explores reform paths from the construction of dual-qualified teachers, optimization of practical training content, and university-enterprise collaborative management. The goal is to connect internship courses with professional job requirements and provide feasible, practical teaching references for cultivating applied talents'

practical ability.

2. The importance of integrating "learning by doing" into internship courses under university-enterprise collaboration

2.1. Promoting the deep integration of the university-enterprise collaborative education system

In recent years, university-enterprise collaborative education has gradually shifted from the superficial "enterprise providing internship places" to the in-depth "co-construction of industry-education integration". Integrating "learning by doing" into internship courses has become an important measure to strengthen cooperation between universities and enterprises. For example, the major of Microelectronic Science and Engineering requires professional experimental equipment and technical resources for professional training, which universities cannot meet independently; enterprises need applied talents matching industrial demands. The two needs can be integrated through "learning by doing" [1].

Based on the "learning by doing" concept, universities and enterprises can jointly formulate internship syllabi for microelectronics and build joint practical training bases. Enterprises provide real working scenarios and technical instructors, while universities give full play to the advantages of theoretical teaching and send professional teachers to participate in guidance, so as to achieve resource complementarity and advantage integration. At the same time, the "learning by doing" teaching model encourages university teachers to take part in enterprise practice of microelectronic projects, continuously improving practical teaching ability in cooperation with enterprise instructors. This is conducive to the construction of a structured "dual-qualified" teaching team, transforming university-enterprise collaboration from single talent output to in-depth integration of curriculum co-construction, teacher co-education and project co-research [2].

2.2. Adapting to the core needs of professional applied talent cultivation

Cultivating applied talents with solid theoretical knowledge and strong practical ability has become the core educational goal of application-oriented universities. The combination of theory and practice is the key to achieving this goal. Conventional internship courses generally have problems, such as a disconnection between content and industrial technology and formalized practical training, which cannot enable students to transform knowledge learned in class into skills for solving practical problems.

"Learning by doing" under university-enterprise collaboration can embed real enterprise working scenarios, project tasks and industrial standards into internship course design. Students apply theoretical knowledge in personal practice and shift from "passive learning" to "active doing". For example, students majoring in Microelectronic Science and Engineering can effectively transform and apply professional knowledge while participating in actual R&D and production operations, making applied talent cultivation more suitable for actual industrial needs [3].

2.3. A key path to empower the cultivation of students' core literacy

At present, industrial talent selection standards have gradually shifted from a single "professional ability" to a comprehensive assessment of professional literacy. Traditional classroom teaching cannot effectively cultivate students' innovative thinking, teamwork and professional literacy.

"Learning by doing" internship courses under university-enterprise collaboration place students in real

enterprise post environments. Through in-depth participation in project practice, students can independently find and solve various practical problems, which fully cultivates their innovative thinking and problem-solving ability. At the same time, the enterprise teamwork model improves students' communication and cooperation ability, helps them fully understand industrial operation specifications and professional ethics requirements, and gradually develops professional literacy matching industrial needs. For example, the cross-post R&D characteristics of Microelectronic Science and Engineering enable students to broaden their professional vision in practice, effectively enhance their employment competitiveness and meet the requirements of industrial talent development [4].

3. Analysis of problems in the construction of the internship curriculum system

3.1. The university-enterprise collaborative education mechanism needs to be improved

Universities and enterprises have not established a long-term and institutionalized collaborative education mechanism. The cooperation model of benefit sharing and responsibility sharing is difficult to implement effectively, resulting in the lack of a suitable system support for "learning by doing" practical teaching.

At present, the cooperation between universities and enterprises mostly stays at the superficial level of resource docking. Enterprises only provide internship places and basic posts for universities, and rarely participate in the development of internship courses, the management of the teaching process and the evaluation of talent training. The joint training bases co-built by universities and enterprises are often formalized, failing to provide standardized and professional practical training scenarios for "learning by doing".

In addition, university-enterprise collaboration lacks a hierarchical management framework and a three-level linkage model of decision-making, management and execution. There is no efficient communication and collaboration mechanism in internship arrangement, resource allocation and process guidance. For example, some majors have higher requirements for practical training equipment and technical resources. The failure of university-enterprise resource complementarity will seriously hinder the development of "learning by doing" internship courses and fail to keep up with the new trend of university-enterprise collaborative education [5].

3.2. Insufficient connection between curriculum content and industrial reality

In the content design of professional internship courses, the core requirements of "learning by doing" practical education are not considered. The university is still the main design body, and the curriculum content is not designed according to industrial development trends and actual enterprise post needs, resulting in insufficient connection with industrial reality.

The update of university internship content often lags behind the pace of industrial technology renewal. It is usually based on basic theoretical verification and simulated operation, without integrating real enterprise project R&D and production process standards into the curriculum system. As a result, "learning by doing" lacks a suitable practical carrier, and students cannot internalize and apply theoretical knowledge in practical operation.

This problem is prominent in technology-intensive majors. For example, the integrated circuit design and semiconductor technology training of Microelectronic Science and Engineering still adopt the conventional school-based simulated training mode, without updating according to new enterprise technology and practical operation requirements. Students' "learning by doing" often stays in simple simulated operation and is difficult

to participate in solving practical industrial problems, which is contrary to the original intention of practical teaching [6].

3.3. Lagging construction of "dual-qualified" teacher team

In the application of the "learning by doing" internship teaching model, higher requirements are put forward for teachers' theoretical teaching level and enterprise instructors' practical teaching ability. However, the current construction of "dual-qualified" teachers is still lagging, making it difficult for teaching guidance ability to adapt to the education needs of "learning by doing".

Although university professional teachers have solid theoretical teaching ability, most of them lack practical work experience in enterprise posts and do not have an in-depth understanding of front-line industrial technical problems and post-operation specifications. They cannot combine theoretical knowledge with enterprise post practice when guiding students' internship, and it is difficult to correctly guide students to find and solve practical problems in the process of "doing".

Enterprise post instructors have rich industrial practical experience, but most lack systematic teaching methods and student guidance skills, and cannot transform post skills into teachable and feasible teaching content. At the same time, there is a lack of corresponding teaching collaboration and joint training mechanism between university and enterprise teachers, making it difficult to complement each other's teaching advantages. For example, in Microelectronic Science and Engineering, university teachers cannot answer practical technical problems in enterprise production, and enterprise instructors cannot guide students to sort out the theoretical logic in practical operation, which will interfere with the teaching effect of "learning by doing" [7].

3.4. Overly single internship assessment and evaluation system

At present, the existing internship assessment and evaluation is out of line with the core requirements of "learning by doing," which emphasizes practical process and professional ability training. There is still a problem of "emphasizing results over process", and the assessment and evaluation system is overly single.

Conventional internship assessment mostly takes the internship reports and summary materials submitted by students as the main evaluation basis, only focusing on the final internship results. It ignores students' practical performance, project participation, problem-solving ability and professional literacy development in the process of "learning by doing", and such evaluation results are not included in the internship assessment system.

In addition, there is still a lack of standardized and refined management modes in the internship process, making it difficult to track and record students' attendance, practical progress and innovative exploration in enterprise internships in real time. Some students' internships are formalized, and the assessment and evaluation results cannot form an effective feedback mechanism, making it difficult to provide strong support for the optimization of the "learning by doing" internship curriculum system [8].

4. System reconstruction and teaching reform measures of "learning by doing" internship courses under university-enterprise collaboration

4.1. Construct a sound three-level university-enterprise collaborative education mechanism

Combined with the new trend of in-depth integration of university-enterprise collaborative education, a

three-level collaborative education mechanism of "decision-making, management and execution" should be constructed to meet the management needs of the whole-process implementation of "learning by doing" internship courses, so that the cooperation between universities and enterprises runs through the entire internship teaching.

The rights and responsibilities of universities and enterprises in the optimization and teaching reform of the "learning by doing" internship curriculum system should be clarified, and a normalized and standardized communication and collaboration mode should be established. Universities and enterprises regularly hold joint meetings to promote work synchronously, transforming university-enterprise collaboration from superficial "resource docking" to in-depth "co-construction and co-management", ensuring the efficient implementation of various measures for internship curriculum reform [9].

The decision-making level consists of university department leaders and enterprise principals to form an internship work leading group, coordinating construction and resource allocation. The management level sets up a university-enterprise joint working committee, responsible for internship plan design and implementation supervision. The executive level forms a teaching practice group by university professional departments and enterprise technical departments, with specific tasks of internship guidance and daily management.

For example, in Microelectronic Science and Engineering, the School of Instrument and Electronics can be the core of the executive level, cooperate with enterprise technical departments to formulate weekly internship plans and practical task sheets, and embed enterprise production management systems into students' daily internship management. In addition, universities and enterprises jointly build collaborative education bases, with enterprises providing important practical training resources and universities providing theoretical teaching support, so as to provide a suitable practical platform for "learning by doing" [10].

4.2. Design a modular and project-based internship curriculum content

Based on university-enterprise collaboration, universities and enterprises should fully understand the professional post ability needs, decompose the core ability goals of different professional internships according to professional talent training goals, abandon the conventional single theoretical verification internship content, and create a modular, project-based "learning by doing" internship curriculum content system.

Real enterprise production projects, process standards and technical requirements are embedded into each curriculum module, making the curriculum content both targeted and practical. The precise connection between internship content and industrial needs is realized, enabling students to transform knowledge learned in class into post-operation skills [11].

In addition, the boundary of internship projects should be expanded according to professional characteristics, and hierarchical practical training content should be designed, combined with the knowledge reserve and cognitive level of students in different grades. An internship curriculum framework of "integration of learning and application, integration of learning and practice" should be constructed, enabling students to gradually improve their practical ability in "learning by doing" at each stage, forming a virtuous circle of theoretical learning and practical operation.

For example, in Microelectronic Science and Engineering, universities can work with local microelectronic enterprises to sort out the ability requirements of key posts such as integrated circuit design and semiconductor process manufacturing, design project-based internship modules such as chip packaging testing and circuit simulation design, abandon the previous school-based simulated training content, enable students to strengthen their practical ability in participating in real enterprise projects, to achieve the goal of

"understanding by doing, practicing by learning" [12].

4.3. Form a dual-qualified and structured teacher team

Using the university-enterprise cooperation platform, a dual-qualified and structured teacher team of "university professional teachers + enterprise post instructors" can be constructed, effectively giving play to the teaching advantages of both parties, continuously improving the complementary level of "learning by doing" internship guidance advantages, and providing professional teacher support for internship teaching.

University professional teachers can deeply understand the cutting-edge industrial technology and actual enterprise production by entering enterprises to participate in project development and take temporary posts in enterprises, continuously improving their industrial practical ability and practical guidance level, and realizing the efficient connection between theoretical teaching and practical operation.

For example, in the internship teaching of Microelectronic Science and Engineering, professional teachers should enter enterprise process workshops, participate in semiconductor material R&D projects, and transform actual enterprise technical problems into scientific research topics in the internship teaching. Enterprises also need to select technical backbones and project leaders as internship instructors, and universities carry out teaching method training to improve their teaching guidance ability, enabling enterprise instructors to effectively guide students to sort out theoretical logic in the process of "doing".

In addition, a teaching collaboration mechanism for university and enterprise instructors should be established to jointly formulate internship guidance plans and carry out "learning by doing" teaching activities. In the internship class of Instrument and Electronics, university and enterprise instructors jointly guide students to complete circuit design practice, realizing the integration of theoretical guidance and practical teaching [13].

4.4. Build a diversified internship assessment and evaluation system

Abandon the previous single assessment mode of "emphasizing results over process". Combined with the core requirements of "learning by doing," focusing on practical process and comprehensive ability cultivation, a diversified assessment and evaluation system combining university-enterprise collaboration, process and results is constructed to comprehensively and objectively evaluate students' internship effectiveness.

The practice process and comprehensive ability performance of "learning by doing" are embedded into the core assessment category, and list-based management and quantitative evaluation are carried out to make the assessment comprehensive and scientific. Process assessment is mainly completed by both universities and enterprises, accounting for more than 60%. University instructors assess students' theoretical application ability, learning attitude and exploration spirit, focusing on students' learning growth and thinking improvement in internships.

Enterprise instructors focus on evaluating students' post-practice standardization, project participation, problem-solving ability and teamwork ability, matching the enterprise post-employment standards [14]. The focus of result assessment is on the actual enterprise project results and internship research reports completed by students, and an objective evaluation is given according to the result defense.

In addition, an assessment result feedback mechanism should be established. The problems found in the assessment are taken as the key basis for optimizing internship curriculum content and adjusting teaching guidance mode, creating an optimization system for "learning by doing" internship courses. For example, in Microelectronic Science and Engineering, the School of Instrument and Electronics can cooperate with

enterprises to formulate detailed internship assessment lists, record and evaluate all operation links and problem-solving processes of students in semiconductor technology practice, integrated circuit design and other projects in the whole process, abandon the traditional evaluation mode of only grading based on internship reports, and fully reflect students' internship effectiveness of "learning by doing" [15].

5. Conclusion

In short, this research focuses on the new trend of combining university-enterprise collaboration and "learning by doing". Based on the importance of integrating "learning by doing" into internship courses under university-enterprise collaboration, it deeply explores the system reconstruction and teaching reform of internship courses, and builds practical measures suitable for applied talent cultivation from four dimensions: curriculum content, collaboration mechanism, teacher team construction and assessment evaluation.

Through the practice of Microelectronic Science and Engineering, the feasibility of internship curriculum system reconstruction and teaching reform in the in-depth integration of industry and education is verified, and the enabling role of combining theory and practice is fully exerted. Relevant measures can provide a practical basis for engineering internship teaching reform, and also lay a solid foundation for the promotion of university-enterprise collaborative education, fully in line with the core requirements of applied talent cultivation in the new era.

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Disclosure statement

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