From "Formal Interdisciplinary" to "Substantive Integration": Exploring a Training Model for AI Interdisciplinary Master's Programs Driven by Intelligent Production Line Upgrade Projects

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Abstract: With the deep integration of Artificial Intelligence (AI) and traditional disciplines, the construction of "artificial intelligence" interdisciplinary master program has become the focus of a new round of higher education reform. Such master programs generally involve the cross training of "artificial intelligence" and "traditional disciplines", and the tutor team is also mostly formed by the tutors of artificial intelligence and traditional disciplines. However, there are two core difficulties in master programs with such teaching team configuration: first, due to the limitation of knowledge structure, non AI professional tutors lack the mastery of cutting-edge AI technology, which is difficult to support the training standard of master programs; Second, some students who have been admitted to the master's degree program are more expected to engage in the cutting-edge directions related to computer science, such as embodied intelligence and computer vision, because their understanding of artificial intelligence mostly starts from the computer related fields, but in fact they are assigned to the tutor group of disciplines such as machinery and materials, resulting in psychological gap and weakening learning motivation. Based on the theory of interdisciplinary training, this paper systematically analyzes the causes of the above-mentioned double dilemma, nd draws lessons from the reform experience of colleges and universities at home and abroad, puts forward the systematic reform path of interdisciplinary training driven by the intelligent industrialization upgrading project, taking the integration of industry and education as the starting point, and provides theoretical and practical reference for breaking through the "formal intersection" dilemma of interdisciplinary AI master training.

Keywords: AI Interdisciplinary Master's Programs; Artificial Intelligence; Interdisciplinary Training; Intelligent Industrialization Upgrading

1. Introduction

In today's era, artificial intelligence technology is being integrated into traditional engineering disciplines such as materials, machinery and control at an unprecedented speed, giving birth to a series of emerging cross cutting research directions such as "intelligent manufacturing", "intelligent materials" and "intelligent construction". In order to comply with the national strategic layout and the future development direction of "new engineering", many domestic colleges and universities have established artificial intelligence interdisciplinary master programs, aiming to cultivate compound high-level talents who not only understand the core technology of artificial intelligence, but also master the knowledge of specific fields.

However, in the specific training practice, this model faces severe challenges. On the one hand, the interdisciplinary tutor team is usually composed of professional AI tutors and traditional subject teachers, and the knowledge structure is quite different. Non-AI professional tutors' understanding of AI technology often stays at the level of "using AI technology", which is difficult to guide students to carry out cutting-edge innovation research, leading to the disconnection between the training content and technology development, and the research content is mostly forced to incorporate AI components. On the other hand, the students of artificial intelligence interdisciplinary subjects are mainly from the background of computer science, machinery and other disciplines. These students may expect to engage in the research of embodied intelligence, computer vision and other core artificial intelligence directions when they enter the University, but due to the

limitations of their tutors' knowledge or the allocation of topics, they are forced to turn to edge interdisciplinary topics such as "artificial intelligence material data analysis" and "mechanical control application", resulting in a psychological gap of "learning is not what they want", which seriously weakens the internal drive of learning.

The fundamental crux of the above two dilemmas lies in that the current interdisciplinary training still stays at the stage of "formal intersection" rather than "substantive integration". Due to the large professional differences, it is impossible to establish a unified research direction, and the tutors of different disciplines are mostly independent, so it is difficult to form an effective collaborative guidance mechanism. How to break through this dilemma and realize the unified training reform with AI technology as the core is the core problem to be solved urgently in the cultivation of interdisciplinary masters in AI.

Based on the systematic review of the theoretical basis of interdisciplinary training and reform experience at home and abroad, this paper deeply analyzes the causes of the above-mentioned double dilemma, and puts forward systematic reform paths such as driving interdisciplinary training with intelligent industrialization upgrading projects, in order to provide reference for the teaching reform practice of similar master programs.

2. The Two Major Dilemmas in the Cultivation of AI Interdisciplinary Master's Programs

2.1 The Asymmetric Imbalance of Supervisors' Knowledge Structures

The professional heterogeneity of interdisciplinary tutor team should have been an advantage for innovation, but due to the lack of experience and specific theoretical guidance in interdisciplinary construction, it has become an obstacle to talent cultivation in the initial practice process. Yang et al. Pointed out in their research that "most of the members of the tutor team come from a single discipline background, and their knowledge system and research vision are often limited to specific fields. When facing interdisciplinary research topics, it is difficult to give comprehensive and effective guidance to graduate students"[1] . In the interdisciplinary of artificial intelligence, this contradiction is particularly prominent.

Specifically, AI professional tutors (such as general AI and embodied Intelligence) focus on cutting-edge fields such as algorithm innovation and model design, while tutors in the fields of intelligent control, machinery and materials mostly regard AI as an auxiliary tool, which can only guide students in shallow applications such as data acquisition, feature extraction or basic modeling. the research of Wang et al. Further confirmed that "the teaching staff is dominated by teachers with a single disciplinary background, which is relatively lacking in interdisciplinary fields, and the contents of different disciplines are simply superimposed, not deeply integrated"[2] . This "asymmetric imbalance" of knowledge structure leads to uneven training quality of students under the guidance of different tutors in the same master's degree program: Students under the guidance of AI professional tutors are exposed to cutting-edge technology, while students under the guidance of non-AI professional tutors are trapped in technology application, resulting in a de facto "training imbalance".

2.2 The Structural Mismatch of Student Expectations and Training Directions

The students of artificial intelligence interdisciplinary are mostly from computer science, mechanical engineering and other professional backgrounds. These students choose to apply for the master's degree, and their implicit expectation is to deeply study the frontier theory and technology of artificial intelligence, such as embodied intelligence, computer vision, large model and other directions. However, due to the limitations of the research direction and subject source of non-AI professional tutors, some students were assigned to the research group in the direction of "AI materials", mainly engaged in applied subjects such as data analysis and mechanical fault diagnosis.

Ji's research pointed out that interdisciplinary graduate students often have the problem of "difficult balance between professional and interdisciplinary learning", and "they have neither refined the professional field knowledge nor thoroughly learned the content of interdisciplinary, resulting in difficulties in graduation and employment"[3] . the survey of Liu et al. Also shows that "the acceleration of technology iteration causes them to have strong

anxiety about the timeliness of knowledge and worry about the rapid obsolescence of what they have learned"[4] · When students with computer background find that their research topic deviates from the frontier of artificial intelligence, they are prone to have "psychological gap" and "marginalized" psychology, ranging from negative coping to antagonistic emotions with their tutors, or even withdraw halfway.

The deep reason for this dilemma is that the current interdisciplinary training still uses the "one size fits all" model, which fails to shunt and match according to the students' disciplinary background and research interest. the research of Lei et al. Summarized this phenomenon as the dilemma of "main discipline attachment" or "multidisciplinary dissociation" - students are either attached to a single discipline or at a loss among multiple disciplines in cross training[5] .

2.3 The Deep Institutional Roots of the Dilemmas

These two dilemmas are not individual cases, but universal institutional barriers in interdisciplinary training. From a macro perspective, Zheng pointed out that "the number of interdisciplinary disciplines required for modern industrial upgrading is relatively scarce, and the training system has not yet formed an effective interdisciplinary mechanism"[6] . Li et al. Analyzed that "the traditional discipline system and scholars solidified the discipline boundary, making joint guidance a mere formality"[7] .

It can be seen that the failure of tutors' knowledge and the dislocation of students' expectations are two sides of the same structural problem: when interdisciplinary disciplines fail to establish an effective tutor collaboration mechanism and classification training system, the "ability weakness" of tutors will inevitably be transformed into the "experience gap" of students. To solve this dilemma, the traditional approach often starts from the system design, and systematically reconstructs the tutor team, curriculum system, training path and evaluation mechanism, but these formalistic reforms cannot completely eradicate the "imbalance" problem formed by the differences in professional structure. the real reform should take the actual projects and courses as the carrier, take the clear and unified objectives as the core, and bring together the mentors of different majors, rather than just carry out the reform from the institutional level. In the face of the rapid development of science and technology today, the traditional manufacturing industry is not only facing the transformation from manpower to automation, but also to intelligence. In the process of intelligent industrialization upgrading, multiple specialties can be effectively combined, so as to realize the real cross unification.

3. A New Interdisciplinary Training Model Centered on "Intelligent Industrial Upgrade Projects"

The traditional cultivation of graduate students is often based on laboratory teaching, that is, to establish a laboratory for the corresponding disciplines, and most of the experiments are completed in the laboratory. Laboratory teaching is only applicable to the postgraduate training mode of a single discipline. Even in the process of some discipline experiments, the data may be processed by artificial intelligence algorithm, but this kind of research is to forcibly combine the artificial intelligence technology with the corresponding discipline technology, and does not really form the cross-integration technology of "artificial intelligence+". Therefore, to break this marginalized cross training mode, one way is to connect as many disciplines as possible in the master's program with a core project in some way, and get rid of the teaching idea of a single laboratory.

With the rapid development of artificial intelligence technology, the traditional manufacturing industry is facing an era of transformation from human processing to automation and ultimately to intelligent processing. Although automated factories have improved production efficiency on the basis of pure human processing, many production processes in automated factories still need human operation and supervision. the development goal of intelligent factories is to achieve a truly unmanned production line, collect data from all links through the industrial Internet, summarize and feedback the production status, and unify the traditional discrete production links into a complete production chain. In addition to the intelligent processes of picking, feeding, production, processing, packaging and palletizing of the overall production line, the embodied intelligent technology can also be used in factory inspection and other links to realize continuous on-site

inspection, timely find production or safety problems, and finally feedback the operation of each link of the production process through the industrial Internet in real time. It only needs a few people in the monitoring room to complete the comprehensive supervision of the entire production line.

The intelligent factory can realize 24-hour non-stop processing. Compared with the automatic production equipment that needs multiple shifts and manual control, the intelligent equipment can unify the equipment of the whole production line, realize unmanned production and processing, and greatly improve the efficiency of the factory. Intelligent factory is the new direction of processing and manufacturing industry in the new era, and the construction of intelligent factory is not simply to replace the traditional process with intelligent equipment. the whole process needs to customize the intelligent production line with different processes according to the actual situation of production and processing.

The whole customization process is not simply to purchase relevant equipment and connect the equipment through the industrial Internet. the integrated design scheme is only the initial stage of upgrading. Most of the time, it is necessary to carry out in-depth transformation of relevant equipment according to the requirements of various links such as factory environmental requirements, process requirements and processing requirements. For example, in the special production environment, the special performance requirements of the intelligent equipment shell and internal electronic components, such as fire resistance, water resistance, corrosion resistance, etc., cannot be handled by a single tutor in the field of artificial intelligence, but tutors in the field of materials can help solve these requirements. In addition, some inspection robots in special environments need more power than robot dogs and wheeled robots that can be purchased in the current market, so that they can have enough power to carry out inspection or return to the charging bin in special environments. In this case, electrical engineers need to modify the battery to meet the demand.

Therefore, the intelligent industry upgrading project can bring together multiple discipline mentors in the master's program to achieve a unified goal. In this process, mentors and students can also participate in the whole process of the project's scheme customization, design, procurement, processing, experiment and online. In addition to mutual learning and communication between tutors, students are deeply involved in the whole project and have deep contact with the actual factory production process. In this process, they complete the intersection and unification of academic and practice, and realize the standardized training of interdisciplinary AI master programs.

While students who are not under the guidance of AI professional tutors, although the part they participate in in the project is not consistent with the expected research direction, the scientific research part they participate in is an indispensable part of the whole process of upgrading the intelligent production line. And in the whole process of completing the project, students cooperate with each other. Even students who are not trained by AI tutors can also participate in AI related scientific research and learn knowledge and practical ability related to their own expectations. Therefore, the training mode driven by the intelligent industrial upgrading project can solve the fundamental problems of "asymmetric imbalance of knowledge" and "dislocation of students' expectations", so that the cultivation of interdisciplinary graduate students can get rid of the "armchair" education mode, and truly realize the interdisciplinary integration with artificial intelligence as the core through such a special project form.

4. Conclusion

This paper analyzes the practical problems faced in the construction of interdisciplinary master's programs: "asymmetric imbalance of tutor's knowledge structure" and "dislocation of students' expectations", which are essentially caused by the failure to fully consider the differences in tutor's knowledge structure in the process of interdisciplinary construction. Therefore, this paper proposes a cross-integration training mode with "intelligent production line upgrading project" as the core. This mode enables students to participate in the research and development process of the project based on the cooperation of multidisciplinary teachers, and gradually bridge the differences in the knowledge structure between tutors. At the same time, it allows students to break away from the traditional laboratory training mode in the project, and jointly realize the project goal of

intelligent industry upgrading through learning different professional knowledge in the actual production process.

It should be pointed out that the training mode proposed in this paper is still in the exploratory stage, and its effectiveness needs to rely on specific teaching practice and long-term follow-up evaluation. the follow-up research can be in-depth in the following two aspects: first, further clarify the selection criteria and implementation process of the intelligent production line upgrading project, and form a replicable and replicable project library; the second is to establish a supporting tutor assessment and student evaluation system, including project participation, interdisciplinary collaboration ability, achievement transformation contribution and other indicators, so as to ensure the sustainable operation of the new model.

To sum up, the cross-integration training mode driven by the intelligent production line upgrading project provides a feasible path to break through the dilemma of "form cross" in the cultivation of master of artificial intelligence interdisciplinary. Through the project link to achieve the dual goals of tutor collaboration and student guidance, it is expected to truly realize the transformation from "seemingly divorced" to "substantial integration", and provide reference for the teaching reform practice of similar master programs.

References

[1] Yang, Gang, Cheng Jinbing, Wang Yinhua. Strategies for Cultivating Graduate Students' Scientific Research Innovation Ability under the Background of Interdisciplinary Integration. Journal of Nanyang Normal University, 2025, 24(5):81-85.

[2] Wang Jianxin, Xia Jiazhi, Duan Guihua, et al. Exploration of Professional Degree Graduate Training Model under "Interdisciplinary Integration and Industry-Education Integration" Taking the FinTech Class of Central South University as an Example. Industry and Information Technology Education, 2026(3):6-10.

[3] Ji Ye. Innovative Graduate Training Driven by Multi-discipline Integration: Essentials, Barriers, and Strategies. Heilongjiang Researches on Higher Education, 2024, 42(9):89-94.

[4] Liu Xuan, Liu Yu. Research on the Psychological Characteristics and Adjustment Mechanisms of Graduate Employment in Universities under the New Engineering Reform. Ability and Wisdom, 2025(36):132-135.

[5] Lei Lei, Chen Yibin, Chen Lingyi, et al. Exploration and Practice of Frontier Interdisciplinary Project - Based Graduate Training in Comprehensive Universities - Taking Nankai University as an Example. Universities and Disciplines, 2026, 7(1):88-97.

[6] Zheng Lijuan. Structural Challenges and Solutions for Building a Strong Graduate Education System during the 15th Five-Year Plan Period. Journal of Southwest Jiaotong University (Social Sciences), 2026:1-11.

[7] Li Bingbing, Guo Guangsheng. Optimization of Collaborative Mechanisms for Interdisciplinary Construction in Research Universities from the Perspective of Integrated Development of Education, Technology, and Talent. China Higher Education Research, 2026(5):44-53.