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Cultivation of Interdisciplinary Intellectual Property Talents in Science and Engineering Universities: Value Implications, System Positioning and Implementation Paths

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Abstract

Interdisciplinary intellectual property talents with both technical expertise and legal literacy underpin the full industrial chain of intellectual property creation, protection and commercialization. China's higher education has developed two training paradigms: the law-centered model and the science and engineering-centered model. The law-centered path faces structural limitations including insufficient technical talent supply and disconnection between theory and practice. The science and engineering-based general education path, while alleviating supply-demand mismatch, encounters pain points of homogeneous curriculum, doctrinal teaching and inadequate practical training. Taking Hangzhou Dianzi University as a case, this study identifies root causes via learning situation surveys, and carries out systematic reforms of modular curricula, project-based teaching and diversified evaluation under the guidance of outcome-based and tailored education. The study verifies that the science and engineering-centered paradigm better fits industrial demands, and the reform effectively improves engineering students' practical competence, providing replicable experience for similar universities.

Keywords

Interdisciplinary intellectual property talents; science and engineering universities; outcome-based education; project-based teaching.

1. Introduction

Against the backdrop of innovation-driven development and the advancement of new quality productive forces, intellectual property stands as a core institutional pillar for technological progress and industrial upgrading in China. The entire chain of intellectual property creation, protection and commercialization relies heavily on interdisciplinary talents who combine solid technical backgrounds with systematic legal literacy. This demand has formed a broad consensus across both industrial and academic circles, as high-tech sectors such as electronic information, national defense engineering and digital cultural creation increasingly require practitioners capable of understanding technical details and applying intellectual property rules in practice. The shortage of such compound talents has become a key constraint restricting the high-quality development of China's intellectual property industry and its technological innovation system.

Taking Hangzhou Dianzi University, a representative science and engineering institution with distinctive electronic information characteristics, as the research case, this paper conducts a systematic learning situation survey covering multi-year course enrollment data, assignment quality assessment and in-depth interviews with faculty members, graduating students and industry intellectual property practitioners. Based on empirical findings, the study breaks away from the traditional logic of legal doctrinal education and proposes four core educational

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concepts centered on demand orientation and tailored instruction. Guided by outcome-based education, the research implements comprehensive reform across five dimensions: stratified modular curriculum clusters, full-process embedded project-based practical teaching, diversified process evaluation systems, and open sharing of teaching resources.

2. Traditional Paths and Practical Dilemmas of Interdisciplinary Intellectual Property Talent Training

2.1. Law-Centered Paradigm with Supplementary General Education in Science and Engineering

2.1.1. Background

Intellectual property talent training in China originated within the legal discipline system. In November 2004, the Ministry of Education and the State Intellectual Property Office jointly issued the Several Opinions on Further Strengthening Intellectual Property Work in Institutions of Higher Education, which encouraged qualified universities to integrate disciplinary resources to carry out intellectual property education. Guided by this policy, many domestic universities independently established secondary disciplines such as intellectual property and intellectual property law under the first-level discipline of law, built a through-training system covering undergraduate, master and doctoral levels centered on legal paradigms, and gradually formed an educational pattern with law as the main body, management and economics as supporting disciplines, and moderate supplementation from multiple interdisciplinary fields. After more than two decades of development, the law-centered paradigm has produced a large number of intellectual property professionals, yet it still has four structural shortcomings that hinder its alignment with the needs of high-quality industrial development. First, there is an overall gap in the supply scale of interdisciplinary intellectual property talents. Second, the implementation of science-education integration and industry-education integration is insufficient, resulting in poor connection between theory and practice. Third, the training system for international legal talents targeting foreign-related scenarios is incomplete. Fourth, the talent structure is overly homogeneous: most graduates enter traditional legal sectors such as courts, procuratorates and law firms, leading to a severe shortage of talents suitable for technical intellectual property positions[1].

2.1.2. Characteristics and Approaches

This situation stems from the fact that the training path is based on law majors. The curriculum system of relevant programs centers on civil and commercial law and intellectual property law, supplemented by practical courses such as intellectual property literature retrieval and intellectual property licensing. Some universities also offer introductory general education courses in science and engineering fields such as mechanics, electronics and chemical engineering, in an attempt to compensate for the technical deficiencies of legal talents[2].

2.1.3. Limitations

Overall, neither the science and engineering foundation of enrolled students nor the fundamental attribute of the discipline itself allows the program to break away from the law-dominated teaching model. In terms of knowledge structure, solid legal knowledge has made indelible contributions to the popularization of intellectual property concepts in China, the confirmation of intellectual property rights especially patent rights, and the establishment of enterprise intellectual property frameworks. Targeted management and economics courses have also improved the knowledge structure of talents and supplied professionals to the high-end intellectual property management industry. Nevertheless, two core limitations remain. On one hand, the primary knowledge background of such talents remains law. A small number of supplementary courses are insufficient for them to acquire solid professional competencies in

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science and engineering. Even if such knowledge is mastered, it remains largely unused as the vast majority of graduates still work in the legal industry, resulting in a waste of educational resources. On the other hand, against the trend of increasingly sophisticated technology industries, this paradigm cannot provide sufficient talent supply for high-tech fields where the country urgently needs breakthroughs.

2.2. Science and Engineering-Centered Paradigm with Embedded Intellectual Property Courses

2.2.1. Background

The supply-demand mismatch and talent structure shortcomings caused by the first path highlight the unique value of interdisciplinary intellectual property education in science and engineering universities, giving rise to a science and engineering-oriented training paradigm that runs parallel to the law-centered path[3]. The educational value of this paradigm has not received sufficient recognition for a long time. General education aims to cultivate well-rounded talents and carries the inherent value of popularizing intellectual property knowledge and awareness. Modest investment in teaching resources lays a foundation for science and engineering students, prepares them for potential intellectual property-related career branches, and builds a basis for knowledge transfer and application. In addition, optional second degree programs provide a solid learning platform for students with strong science and engineering backgrounds who aspire to pursue careers in intellectual property, offering significant advantages in talent suitability.

As science and technology advance, professional division of labor becomes increasingly refined, making technical details inaccessible to non-professionals. Even law students with professional legal training cannot fully handle related legislative and judicial activities involving specialized technical content. Therefore, students with dual backgrounds in law and relevant technical disciplines play an irreplaceable role in these specific fields. This represents a unique advantage for engineering universities in cultivating law talents with distinctive features, and best embodies the characteristics and value of legal education in engineering institutions. Specifically, legal education in engineering universities must make full use of their advantageous engineering resources, develop specialized courses and teaching materials, and implement multi-disciplinary joint teaching. This integration of mainstream and characteristic teaching strengthens both the instruction of basic professional courses and practical ability training, while enabling students to acquire knowledge in other fields, thus cultivating interdisciplinary legal talents with diverse knowledge structures and multiple competencies[4].

The science and engineering-oriented training path was developed simultaneously with the law-centered path. The document explicitly requires universities to popularize intellectual property courses for science and engineering students, so as to strengthen awareness of innovation protection from the source of research and development.

This policy has received rapid responses from science and engineering universities, many of which have also established intellectual property programs. In terms of program setup, such initiatives still fall under the first path, as intellectual property programs offered by science and engineering universities remain subordinate to the law discipline. The second path specifically refers to dedicated intellectual property general education courses for science and engineering majors, or the option of a second degree in intellectual property for such students, as a means of cultivating interdisciplinary talents.

2.2.2. Specific Practices and Advantages

Engineering-focused universities have inherent advantages in cultivating legal talents with specialized characteristics. Relying on their engineering background, they can identify several specialized directions at the intersections of different disciplines to develop their own

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educational features. This approach not only leverages their strengths and establishes a reasonable positioning, but also avoids the waste of educational resources caused by blind expansion, and facilitates the formation of emerging disciplines that meet the needs of scientific, technological and social development[5].

The goal of legal education in engineering universities should first be positioned as general education, supplemented by dual-degree programs and minor courses. This approach brings at least two core advantages.

First, it builds a solid intellectual property foundation for future scientific and technological talents. Taking patents as an example, the shortcomings of the current law-dominated talent training model are particularly prominent in the patent field. Many scientific and technological talents lack understanding of the patent system and fail to grasp that patent grant does not equal high patent quality. This leads to a large number of granted patents with low quality, and numerous cases of patent invalidation that hinder rights enforcement. Such issues not only reflect problems in patent quality, but also waste judicial resources and dampen the innovation enthusiasm of scientific and technological personnel. Appropriate intellectual property education can fundamentally address the lack of intellectual property awareness and knowledge among Chinese scientific and technological personnel, and is expected to shape a new patent application landscape led by technical professionals in the future. This will promote China's transformation from a large patent country to a strong patent power, support the development of new quality productive forces, and enable high-quality development[6].

Second, it enables more precise industry-education integration. Through a small number of general education courses, minor courses and second degree programs, the model provides a platform for interested students to further study intellectual property, while avoiding imposing unnecessary knowledge on uninterested students.

2.2.3. Limitations of the Second Path

Nevertheless, the unified general education teaching model has four practical pain points. First, the lack of stratified and categorized courses fails to match the learning needs of different majors, resulting in low student motivation. Second, statute-based theoretical teaching contradicts the practical thinking mode of engineering students, leading to low classroom acceptance. Third, the absence of practical training such as patent retrieval, copyright deposit and infringement analysis results in poor knowledge retention. Fourth, teaching content is disconnected from the real demands of positions such as enterprise patent engineers, military industry compliance officers and cultural and creative copyright risk controllers, making it difficult to translate into students' research and employment competitiveness. Meanwhile, this model also imposes higher requirements on the specialized configuration of courses and the adaptability of teaching materials[7].

3. Experience of General Education Implementation at Hangzhou Dianzi University

3.1. Undifferentiated Curriculum Without Stratified Modules and Severe Divergence in Student Learning Willingness

The university offers a complete set of unified intellectual property general education courses without designing differentiated content based on students' majors. Students majoring in journalism and digital media only focus on copyright rules for software, live streaming and AI-generated content, and show no interest in topics such as patent application and patent retrieval. Students majoring in electronics and computer science primarily demand knowledge of patent layout and trade secret protection, and have very low participation in content related

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to trademarks and cultural and creative copyright. The unified curriculum system leads to waste of learning resources and insufficient student initiative.

3.2. Traditional Teaching Paradigm and Disconnection Between Doctrinal Legal Theory and Engineering Students' Cognitive Logic

Courses adopt a traditional law teaching model centered on statute explanation and legal reasoning. Highly abstract legal interpretation and logical argumentation are incompatible with engineering students' thinking mode that emphasizes practical operation and engineering cases. The hollow and tedious theoretical teaching fails to stimulate learning enthusiasm among engineering students[8].

3.3. Absence of Practical Teaching Links and Low Knowledge Retention

Courses are dominated by theoretical instruction and lack practical training in patent retrieval, software copyright registration, blockchain evidence deposit, patent early warning and enterprise confidentiality compliance. Students only passively memorize legal provisions without hands-on application scenarios. They quickly forget the knowledge after the course ends, and fail to form long-term knowledge reserves.

3.4. Insufficient Course Practicality and Lack of Effective Support for Students' Employment and Research

Existing courses do not align with the real demands of positions such as enterprise patent engineers, intellectual property managers in research institutes, and cultural and creative copyright risk controllers. They also fail to design practical training content combined with the university's own scenarios of national defense research and electronic information achievement transformation. As a result, course learning cannot be translated into core competitiveness for students' research and job hunting, weakening the educational value.

4. Specific Teaching Reform Measures

Based on the above educational concepts, Hangzhou Dianzi University implements systematic reform from five dimensions: curriculum system, teaching model, practical carriers, assessment and evaluation, and open teaching resources.

4.1. Construction of Stratified and Categorized Modular Intellectual Property Curriculum Cluster

The single general education curriculum structure is broken down, and four independent course modules are divided according to students' major attributes. Students select courses independently based on their own majors and research directions to achieve tailored teaching.

The first module focuses on patents and research achievement transformation. Targeting engineering majors such as electronic information, automation and mechanics, it covers general patent and national defense patent layout, patent retrieval, PCT international applications, patent early warning, and ownership division of university-enterprise research achievements. The second module covers digital copyright. Designed for computer science, digital media and journalism and publishing majors, it explains software registration, platform safe harbor rules, blockchain evidence preservation, copyright risks of AI-generated images, game live streaming and large model training. The third module addresses trade secrets and military industry confidentiality. For engineering majors with national defense characteristics, it focuses on classified technology protection, confidentiality agreements and intellectual property compliance of military projects. The fourth module involves trademarks and sci-tech brand operation. Targeting economics, management and design majors, it covers trademark layout of technology enterprises and intellectual property operation of sci-tech brands. Each

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module has independent class hours and is equipped with exclusive cases and practical training content. Students only select modules matching their own majors, avoiding learning burnout caused by irrelevant content[9].

4.2. Full Integration of Practical Teaching and Implementation of Project-Based Classrooms

Taking real industrial projects and on-campus horizontal research projects as core carriers, project-based teaching is fully implemented to replace traditional statute lecturing. For the patent module, practical training is conducted based on patent retrieval databases, covering technical solution mining, patent infringement analysis report writing and patent early warning document drafting. For the copyright module, simulations are carried out for online software copyright registration, blockchain intellectual property evidence deposit, and copyright dispute mediation for short video live streaming. For the military industry confidentiality module, compliance cases from local military enterprises are introduced to carry out group assignments on intellectual property risk investigation of classified technologies. Students follow a complete set of intellectual property practice projects in groups, completing the entire process of data retrieval, document writing, risk assessment and solution output, realizing immediate transfer and application of theoretical knowledge.

4.3. Reconstruction of Diversified Credit and Comprehensive Evaluation System

4.3.1. Establishment of Process-Based Comprehensive Evaluation Criteria

The single assessment model that determines grades solely by a final exam is replaced by a process-based comprehensive evaluation standard, with credit allocation tilted toward practical projects, classroom discussions and practical outputs. The total course grade consists of four parts: classroom thematic discussions, project training reports, practical document works and a simple final assessment. The proportion of pure theoretical memorization scores is reduced, with focus on assessing students' practical ability to apply intellectual property knowledge to solve problems in professional scenarios[10].

4.3.2. Promotion of Open-Source Course Resources and Inclusion of Open-Source Contributions in Assessment

The reform innovates the teaching resource construction and assessment mechanism, promotes the open-source sharing of full sets of intellectual property courseware, training cases and operation manuals, and builds an on-campus open-source library of intellectual property teaching resources. Students' contributions of supplementing, revising and expanding the open-source case base and training materials are included in the usual course grades. Students are encouraged to sort out typical industry intellectual property cases and practical procedures combined with their own majors, forming a co-constructed and shared teaching resource ecosystem, and simultaneously exercising students' abilities in data sorting and intellectual property case analysis. The open-source link helps strengthen dialogue between teachers and students, as well as between current and former students, facilitates clearer mapping of knowledge graphs, and enhances comprehensible input.

5. Conclusion

This study clarifies the advantages and disadvantages of the two training paths for interdisciplinary intellectual property talents, and demonstrates that the science and engineering-centered training paradigm is more compatible with the current recruitment and practical operation demands of the domestic intellectual property industry. It constructs a modular curriculum education framework based on OBE and tailored teaching concepts,

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enriches the theory of interdisciplinary technology plus law talent training under the background of emerging engineering education, and addresses the perspective limitation of existing studies that focus heavily on the law school path.

The modular curriculum cluster solves the pain points of homogeneous content and low student interest in traditional general education courses, and accurately matches the learning needs of different majors such as electronic information, digital media and national defense industry. Project-based practical teaching and the open-source assessment system break down barriers between theory and practice, improve engineering students' intellectual property practical abilities, and strengthen the supporting role of courses in students' research and employment. The entire reform plan, developed based on science and engineering universities with electronic information characteristics, can be replicated and promoted to similar science and engineering institutions, delivering more interdisciplinary intellectual property talents with both technical backgrounds and legal literacy to the industry.

Future work will continue to expand the coverage of modular courses, deepen the construction of industry-education integration training bases with patent law firms and military technology enterprises, continuously iterate the open-source case base, track long-term data on graduate employment and research achievement transformation, and steadily improve the science and engineering-oriented interdisciplinary intellectual property talent training system.

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