Research on the Construction of Educational Innovation Ecology and the Coordinated Development Strategy of Resources under the Background of Strengthening Intellectual Property Protection

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[**Abstract**] Under the background of digital transformation and innovation drive, the improvement of intellectual property protection level has a profound impact on the innovation ecology, resource allocation and talent training in the field of education in China. Focusing on the particularity of the education scene, this paper analyzes the dual effects of protection and strengthening: the coexistence of technological innovation incentives and resource circulation barriers, the shortage of grassroots resources and the idle symbiosis of university achievements, and the weak awareness of students and the lack of teachers' ability.

[**Key words**] intellectual property protection; educational innovation ecology; resource collaboration; full-cycle education; cultivation of innovative talents

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1 Introduction

Under the background of the deep integration of global digital transformation and innovation-driven development strategy, intellectual property rights, as the strategic resources of national development and the core elements of international competitiveness, are integrating into the whole chain of education with unprecedented depth and breadth. As a basic project for the cultivation of knowledge production and dissemination and innovative talents, education not only undertakes the important mission of transforming the intellectual property system into the driving force of innovation, but also faces the structural challenges brought by the improvement of protection level. From the perspective of international trends, the release of the World Intellectual Property Organization's Guidelines on Intellectual Property Rights in Education and the strengthening of copyright management by the EU's Digital Education Action Plan mark that the global education field has entered a new stage of "co-evolution of innovation protection and resource circulation"; from the perspective of domestic demand, China's "14th Five-Year Plan" clearly proposes to "strengthen the protection of intellectual property rights and build an innovative country". As the main position of cultivating innovative talents, education urgently needs to build an intellectual property governance system that is compatible with the new era. At present, the issue of intellectual property rights in the education scene presents significant complexity and uniqueness: the definition of the ownership of teaching content generated by artificial intelligence is vague, the cross-regional sharing of digital teaching materials faces copyright barriers, the transformation of scientific research achievements in colleges and universities is structurally disconnected from the needs of grassroots education, and the lack of intellectual property awareness and innovative practical ability of teachers and students is intertwined, which restricts the high-quality development of education. For example, an online education platform has caused tens of millions of losses due to copyright disputes over user-uploaded content, exposing the institutional blind spot of digital education resource governance; due to the high cost of obtaining patent teaching equipment, rural schools in the central and western regions are forced to use

backward teaching aids, which highlights the imbalance of resource allocation. These problems not only affect the fairness and efficiency of education, but also affect the foundation of the national innovation system. In this context, in-depth study of the impact mechanism and coping strategies of strengthening intellectual property protection in the field of education has distinct value of the times and practical urgency. Taking the particularity of education scene as the breakthrough point, this study focuses on the three core dimensions of teaching innovation, resource allocation and talent training. It aims to reveal the internal logic of the improvement of protection level and the development of education, and explore the collaborative path of "stimulating innovation-optimizing allocation-cultivating consciousness", so as to provide theoretical support and practical scheme for China to balance intellectual property protection and public interest and enhance international competitiveness in the process of education modernization. Through interdisciplinary research perspectives and empirical analysis, we try to break through the institutional framework of traditional intellectual property research, build a protection and development paradigm with the characteristics of the education industry, and provide decision-making reference for the coordinated promotion of the "education power" and "intellectual property power" strategies.

2 The multi-dimensional impact of strengthening intellectual property protection in the field of education

2.1 "Double variation" of teaching innovation: coexistence of incentive and constraint

The intellectual property system has a significant driving effect on educational technology innovation. Taking patent protection as an example, the investment of universities and educational technology enterprises in the research and development of intelligent teaching tools continues to increase: through the patent layout, the "AI intelligent learning situation analysis system" developed by a 985 Project university not only realizes the accurate tracking of students' learning trajectory, but also attracts enterprises to invest in establishing joint ventures to promote the popularization of technology to primary and secondary schools. The relevant results have been applied in more than 300 schools across the country. Similarly, the application patents of virtual reality (VR) technology in history teaching (such as "immersive historical scene reconstruction system") have increased students' participation by more than 40% by restoring the scene of historical events, and related courses have been included in the construction project of national excellent online open courses.

However, excessive protection will lead to the tendency of "privatization" of educational resources. A regional education alliance once planned to build a cross-school online course platform, but it was shelved due to the high cost of copyright licensing for foreign textbooks (the annual licensing fee for a single textbook exceeded 100,000 *yuan*), resulting in a two-year delay in the regional high-quality curriculum co-construction plan. The phenomenon of "format lock" in the field of digital textbooks is more prominent: in order to protect copyright, some publishers lock textbooks into exclusive reading formats and restrict teachers' secondary processing according to their learning situation. A provincial survey shows that 73% of teachers think that the existing digital textbooks are "inflexible", which is difficult to meet the needs of differentiated teaching and restricts classroom innovation practice.

2.2 The "ice and fire double days" of the circulation of educational resources: coexistence of surplus and shortage

Schools in rural and remote areas are facing severe resource acquisition difficulties. Taking teaching materials as an example, the price of authentic digital teaching materials is usually 2 ~ 3 times that of the paper version, while the coverage of audio-visual equipment in rural schools in a county in the central and western regions is less than 50%. Teachers have to download pirated courseware through informal channels. A survey shows that 62% of rural teachers have caused copyright disputes due to the use of unauthorized teaching materials. The application gap of patent teaching equipment is more significant: there is 3.2 educational technology patent conversion equipment per capita in middle schools in the eastern developed areas, while the data of similar schools in the west is only 0.5, and the difference in equipment coverage is 540%.

In stark contrast, a large number of scientific research achievements in colleges and universities are idle. According to the data from the Ministry of Education, in 2023, more than 40,000 new teaching-related patents will

be added in colleges and universities nationwide, but the conversion rate is only 12.7%, roughly equivalent to half of the international average (25%). Taking a normal university as an example, its patent of "low-cost chemical experimental device" (which can reduce the experimental cost by 60%) is only used in the laboratory of the university due to the lack of promotion channels, while 80% of rural middle schools in China are still using traditional hazardous reagents, resulting in a structural disconnection between "laboratory results" and "front-line needs".

2.3 "Consciousness gap" of talent cultivation: double deficiency of cognition and ability

The weak awareness of intellectual property rights of youth groups needs to be solved urgently. According to a national survey, 78% of middle school students do not know that "the source of the reproduced network pictures needs to be indicated", and 45% of college students have irregular citation behavior in the course papers; the problems of vocational college students are more prominent. In the graduation design of a higher vocational college, 63% of the works involve material infringement, 21% of which directly copy the commercial software interface, reflecting the lack of systematic education. This lack of cognition not only leads to the risk of infringement, but also inhibits the enthusiasm of innovation—only 23% of middle school students are willing to patent their ideas, far lower than the average level of 51% in developed countries, and the soil for innovation cultivation needs to be improved.

The lack of intellectual property knowledge reserve of teachers has become the bottleneck of innovative education. A survey of 1,000 primary and secondary schools across the country shows that only 18% of teachers have received systematic intellectual property training, and 52% of teachers cannot distinguish the boundary between "fair use" and "infringement", which is easy to cause compliance risks when guiding students' competitions or scientific research. In colleges and universities, there are frequent disputes over the transformation of scientific research achievements. In the past three years, there have been 17 cases involving disputes over the ownership of teachers' service inventions in a "double first-class" university, exposing the loopholes in the intellectual property management mechanism of colleges and universities, which urgently need professional management and system construction.

3 The three-dimensional collaborative strategy of intellectual property protection and development in the field of education

3.1 Hierarchical and classified innovation incentive mechanism: solving the "protection paradox"

The difference in the attributes of innovation achievements determines the distinction between protection and circulation strategies. For basic teaching results (such as teaching design, and open class resources), it is necessary to build an open ecology oriented by sharing. Relying on the "education innovation public resource pool", the knowledge sharing agreement (CC agreement) can be used to promote the circulation of non-commercial achievements, and the contribution of resources can be included in the teacher evaluation system to encourage the continuous output of high-quality content. For example, the "Local Culture School-based Curriculum Package" of a middle school in Zhejiang is used for reference by more than 200 schools across the country through the public resource pool, forming a virtuous circle of "creation-sharing-improvement".

For applied technology achievements (such as educational technology patents), it is necessary to establish a differentiated ownership distribution mechanism. For high value-added patents, the "inventor-school-enterprise" revenue sharing model is implemented. For example, on the "intelligent homework correction system" patent of a university, the inventor can obtain 40% license income, which stimulates innovation motivation; compulsory licensing of inclusive patents requires patentees to open the right to rural schools at cost price, and the government compensates them through tax relief, so as to achieve a balance between technological innovation and educational equity.

3.2 Accurate and efficient resource circulation system: opening up the "last mile"

Constructing a three-level collaborative network of "provincial resource center—city sub-center—county service station" is the key to solving the dilemma of resource circulation. Provincial centers integrate genuine resources through government purchase services to reduce grassroots access costs (for example, the "Guangdong

Education Resources Cloud Platform" in Guangdong Province has reduced the subscription cost of rural schools by 84%); municipal sub-centers are responsible for demand docking and directional push (for example, the Pearl River Delta transports "manufacturing skills training package" to the northern mountainous areas of Guangdong); the county service station is served by teachers as liaisons to achieve accurate response to personalized needs.

In view of the problem of patent transformation in colleges and universities, the system of "patent simple application package" is implemented, and the complex technology is disassembled into an operational implementation plan for teachers. For example, a university's "3D printing teaching model" patent has been promoted through the community, and more than 300 practical applications of secondary vocational schools have been derived, and short video tutorials and online workshops have been developed to form a transformation chain of "technical dismantling—training guidance—practical application", which significantly reduces the threshold of grassroots application.

3.3 Full-cycle embedded education system: cultivating innovation and protection culture

The cultivation of students should follow the law of step-by-step growth: in the basic education stage, through the enlightenment of "morality and rule of law" curriculum, the copyright consciousness is strengthened by practical activities such as "campus cultural and creative market set"; in the stage of vocational education, the module of "commercial copyright management" is added to the professional courses, which is integrated into the practical training of e-commerce trademark registration, short video material audit and so on; in the stage of higher education, "academic norms and innovation protection" is set as a compulsory course, and the combination of science and law disciplines is promoted to carry out patent practical projects and cultivate interdisciplinary application ability.

The improvement of teachers' ability depends on precise training and institutional guarantee. The induction training of new teachers should cover the practice of courseware material authorization, student work ownership and so on. Backbone teacher training focuses on cutting-edge issues (such as copyright ownership of AI-generated content) to form professional guidelines; colleges and universities set up a "teacher innovation rights service center" to provide one-stop service for patent application, and clarify the proportion of income distribution of service inventions through the articles of association (the team can control no less than 70%), so as to stimulate innovation enthusiasm from the institutional level.

4 Implementation path and guarantee mechanism

4.1 Regional differentiation pilot project: building a multi-level innovation model

Regional pilot project is the key link to verify the effectiveness and adaptability of the strategy. China has a vast territory and significant differences in the level of education development. It is necessary to carry out hierarchical classification pilot projects according to the resource endowments and demand characteristics of different regions.

The eastern developed areas: relying on the Yangtze River Delta, the Pearl River Delta and other educational information highlands, and focusing on exploring the "market-oriented transformation + cross-regional collaboration" model. Taking Shanghai, Hangzhou and Shenzhen as the core nodes, we will establish an "Education Intellectual Property Collaboration Alliance" to open up the whole chain of university patents from research and development to application. For example, the patent of "intelligent laboratory safety monitoring system" developed by a university in Shanghai connects with 20 middle schools in Hangzhou, Suzhou and other places through the alliance platform, realizes the unification and large-scale application of technical standards, and reduces the procurement cost of single school by 60%. At the same time, the cross-regional resource copyright sharing mechanism is explored, such as the "artificial intelligence foundation" course jointly developed by the Yangtze River Delta region, using the "one-time creation, multi-school authorization" model, and the copyright income is dynamically allocated according to the number of schools using it, to stimulate the vitality of regional collaborative innovation.

The underdeveloped areas in the central and western regions: taking Gansu, Yunnan and other provinces as pilot areas, and focusing on "inclusive patent promotion + grassroots capacity building". The "Hundred Counties and Thousand Schools Patent Benefit Education Project" launched by Gansu Province has achieved initial results:

100 patents suitable for rural schools (such as solar energy teaching equipment and low-cost scientific experimental devices) are screened, and they are authorized to 1,000 rural schools through government financial subsidies in the form of "zero license fee", and the "rural innovation tutor" training program is carried out to train 1,000 grassroots teachers with patent application guidance ability within 3 years. Yunnan, through the "Support Plan for the Copyright of Educational Resources in Border Ethnic Areas", gives priority to copyright registration, tax reduction and other policy support to the creation and dissemination of minority language teaching materials, which not only protects the achievements of cultural innovation, but also promotes educational equity.

4.2 Technology enabling system: building an intelligent management platform

Technological innovation is the core driving force to improve the efficiency of intellectual property governance. Develop the "Education Intellectual Property Intelligent Housekeeper" system, integrate the four functional modules, and realize the digital management of the whole process:

Intelligent detection module: Using image recognition, text comparison and blockchain technology to achieve real-time copyright detection of courseware, papers, short videos and other teaching resources. After using this module in a pilot middle school, the proportion of unauthorized pictures and audio materials in teachers' courseware decreased from 35% to 5%, and the incidence of infringement disputes decreased by 80%.

Accurate matching module: Based on multi-dimensional labels such as types of educational institutions (such as primary schools, secondary vocational schools, and colleges and universities), subject needs (such as science and technology, and art), and regional characteristics (such as rural areas, and cities), a national education patent and resource database is established to intelligently recommend suitable patent technologies and digital resources. For example, after vocational colleges input the demand of "industrial robot training", the system can automatically match the simple application scheme, training course package and enterprise cooperation resources of relevant patents.

Convenient authorization module: It provides standardized electronic authorization protocol templates, covering different scenarios such as non-commercial use, adaptation and dissemination, and commercial development, and realizes online application, review and signature of resource licenses. When a university teacher applies for the use of foreign textbook chapters, the average time to complete the copyright clearance through this module is shortened from 3 months to 7 working days.

Data tracking module: Record the trajectory and effect feedback of resource use, and form a closed loop of "application - use - evaluation - improvement". For example, after a rural school uses the "portable physics experiment box" patent, the system automatically collects data such as experiment output rate and students' feedback, which provides a basis for the patent inventor to improve the design and the education department to optimize the allocation of resources.

4.3 Multi-ecological cultivation: building a collaborative governance alliance

Intellectual property governance is a systematic project, which needs to integrate the government, universities, enterprises, judicial organs and other multi-subject forces to form a coordinated co-governance pattern.

At the policy guarantee level: The education administrative department and the intellectual property management department jointly issued the "Guidance on the Protection and Application of Intellectual Property Rights in the Field of Education" to clarify the key policies such as the proportion of income distribution of service inventions in colleges and universities (not less than 70% of the team's disposable) and the reasonable use boundary of digital resources, so as to provide legal basis for practice. For example, the Guangdong Provincial Department of Education and the Provincial Intellectual Property Office jointly issued the "Guangdong Provincial Education Patent Transformation Incentives" to give additional incentives to university teams that promote the application of patents in the field of basic education.

Industry collaboration level: The "China Education Intellectual Property Innovation Alliance" was established, members of which include 985 Project universities, leading education technology companies, intellectual property service agencies and local education administrative departments. Since the establishment of the alliance, more than 300 university patents have been promoted to meet the needs of enterprises, 50 "education patent transformation demonstration bases" have been established, and 12 group standards such as "online

education resource copyright management standards" and "vocational education patent application norms" have been issued to fill the gap in industry norms.

Judicial service level: In Hangzhou Internet Court, Guangzhou Intellectual Property Court, etc., a "fast-track court for educational intellectual property disputes" was established, and a "fast-file, fast-trial, and fast-track" mechanism was implemented for cases such as courseware infringement and scientific research achievement ownership. In the infringement case of an online education platform in 2024, the court quickly determined the infringement facts through the blockchain certificate technology. It only took 15 days from filing to judgment, which greatly improved judicial efficiency.

4.4 Long-term financial support: establishing a multi-channel investment mechanism

Adequate financial security is a necessary condition for the implementation of the strategy. It is necessary to build a diversified investment system of "government guidance—social participation—results feedback":

Government finance special: The central and local finances set up "special funds for the development of educational intellectual property rights" to support public welfare projects such as the construction of public resource pools, grassroots patent promotion, and teacher training. For example, in 2024, the central government arranged a special fund of 500 million *yuan* to focus on supporting the application of patent teaching aids and the procurement of digital resources in 1,000 rural schools in the central and western regions.

The introduction of social capital: Attract enterprises to participate in the development of educational intellectual property rights through government purchase services and PPP models. An educational technology enterprise, in cooperation with the local government, invested 200 million *yuan* to build a "regional education resource copyright trading center", which not only provides genuine resource services for schools, but also realizes sustainable operation through transaction commissions.

Achievement income feedback: It is stipulated that 10% ~15% of the patent transformation income of colleges and universities must be used to set up an "education innovation fund" to support students' innovation and entrepreneurship projects and grassroots education assistance. In the past three years, a university has invested 8 million *yuan* through this mechanism to subsidize more than 200 student innovation teams, of which 35 achievements have applied for utility model patents.

4.5 Professional talent reserve: improving the multi-level training system

The improvement of intellectual property governance ability lies in the cultivation of professional talents. It is necessary to establish a multi-level talent training system of "academic education + vocational training + practical exercise":

Intensification of academic education: In order to cultivate compound talents with knowledge of pedagogy, law and management, an interdisciplinary subject of "educational intellectual property" is added in colleges and universities. At present, Renmin University of China and East China University of Political Science and Law have set up master's degree programs in related fields, covering education patent layout, digital copyright management, international education rules and so on.

Vocational training system: Customized training is carried out for different groups such as education administrative departments, school administrators and teachers. For example, the National Institute of Education and Administration holds a "National Advanced Training Course on Educational Intellectual Property Management" every year, inviting judges, patent agents and other practical experts to teach, and the total number of trainees is more than 5,000.

Practice base construction: Set up "education intellectual property training base" in intellectual property service institutions and educational technology enterprises. College students participate in practical work such as patent application and infringement analysis through internship, so as to shorten the distance between theory and practice. A training base established by an intellectual property agency company in cooperation with universities has trained more than 200 professionals who can independently complete patent writing in the field of education.

Through the coordinated promotion of the above implementation path and guarantee mechanism, China's education field is gradually forming a new pattern of intellectual property governance with "policy support, technology guarantee, subject vitality, capital source and talent reserve", laying a solid foundation for innovation-

driven high-quality development of education.

4.6 Regional pilot project: creating a differentiated innovation model

The developed eastern regions focus on "market-oriented transformation + cross-regional sharing". The regional development of educational intellectual property rights in China shows significant gradient characteristics, and it is necessary to achieve precise breakthroughs through differentiated pilot projects. In the eastern developed regions such as the Yangtze River Delta and the Pearl River Delta, relying on a strong industrial base and an active market economy, we focus on building an innovative model of "market-oriented transformation + cross-regional sharing". Taking the "Yangtze River Delta Education Intellectual Property Collaboration Platform" as an example, the platform has promoted the application of 100 university patents in 120 schools by establishing a patent value evaluation system, a technology transaction matching mechanism and a cross-domain income distribution system. Among them, Shanghai Jiao Tong University's "AI Teaching Assistance System" patent has completed cross-provincial authorization through the platform, generating direct economic benefits of more than 30 million *yuan* in schools in Jiangsu, Zhejiang and other places, forming a virtuous cycle of "R&D—transformation—feedback".

In view of the relatively weak educational resources in the central and western regions, the pilot project focuses on the two-wheel drive of "inclusive promotion + awareness promotion". The "Hundred Counties and Thousand Schools Patent Benefit Education Project" implemented in Gansu Province has typical demonstration significance. Through the establishment of the western education patent pool, 100 utility model patents suitable for the county education scene are screened, and the "free authorization + localization transformation" mode is adopted. For example, the "multifunctional portable teaching experiment box" patent developed by Northwest Normal University has been popularized in 30 schools in poverty-stricken counties, and the cost has been reduced by 40% after the secondary development of local enterprises. The "Rural Innovation Tutor" training plan, which is carried out simultaneously, trains thousands of backbone teachers through the combination of online and offline training, so that they have the ability to improve the application of patents, and form a sustainable development path of "technology input—talent incubation—independent iteration".

4.7 Technology empowerment: building an intelligent management platform

Digital technology has injected new momentum into the management of educational intellectual property rights. As the core carrier, the "education intellectual property intelligent housekeeper" system constructs the whole chain service system of "monitoring-matching-trading-rights protection". At the level of copyright protection, blockchain technology is used to realize the confirmation and preservation of works. Through AI image recognition and semantic analysis technology, a copyright feature library covering textbooks, courseware and teaching videos is established. In practical applications, after a provincial education resource platform is connected to the system, the infringement detection rate is reduced from 35% of traditional manual screening to 8%, of which 90% of low-risk infringements are quickly rectified through automatic notification.

The patent matching module uses knowledge graph technology to accurately connect 28,000 educational patents with school needs. By analyzing the data of discipline construction and equipment configuration of the school, the system intelligently recommends and adapts patents. For example, after a county-level middle school in Guizhou Province entered the demand for "physical experiment equipment upgrade", the system immediately pushed 17 corresponding patents, and displayed evaluation indicators such as patent maturity and implementation cost. The online protocol signing function integrates electronic signature and smart contract technology, compresses the authorization process that originally required two weeks to 2 hours, and increases the contract performance rate to 98%.

The platform also innovatively develops the function of "dynamic evaluation of patent value", and builds an evaluation model based on regional education investment and school procurement data. For example, the "Smart Classroom Interaction System" patent held by an educational institution, which analyzes the information budget of 300 potential purchasing schools, predicts that its market value range is 80~1.2 million *yuan*, and provides data support for pricing decisions. In addition, the rights protection assistance module is connected to the judicial blockchain certificate center to realize the instant solidification of infringement evidence. The piracy course case of a training institution is certificated through the platform, and the rights protection cycle is shortened from 180 days

to 45 days.

Technology empowerment requires new infrastructure: local education departments build regional data centers, and the Ministry of Education leads the establishment of a national education patent big data center, which has gathered more than 500,000 pieces of patent information. At the same time, we will promote the construction of the standard system, clarify the technical standards such as data interface and encrypted transmission, and ensure the interconnection between systems. In the future, AI technology applications will be deepened, such as the development of automatic assessment tools for patent technology maturity, and the use of machine learning to predict the commercialization potential of technology.

5 Conclusion and prospect

Strengthening the protection of intellectual property rights is the only way for the transformation of education to high-quality development. Its core lies in grasping the dynamic balance between "protection" and "development". Through the analysis of key links such as innovation incentives, resource circulation, and talent training in the education scene, this study proposes a three-dimensional strategy system of hierarchical classification incentives, precise circulation, and full-cycle education, aiming to build a new type of ecology that safeguards innovation rights and promotes education equity. At the practical level, the differentiated exploration of the regional pilot project has achieved initial results: the eastern region promotes the large-scale application of university patents through cross-regional cooperation platforms, the central and western regions rely on the promotion of inclusive patents to narrow the resource gap, and the technology enabling platform improves the efficiency of the whole industry through intelligent management. These explorations confirm the effectiveness of the path of "institutional innovation + technical support + ecological synergy", and provide a reference model for nationwide promotion.

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