

Research on the development path of integration of blockchain technology and higher education in China

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Abstract:

In recent years, along with the introduction of blockchain technology into the field of education, "blockchain + higher education" has become an important engine to promote the change in higher education and an important direction and trend of future education development. Blockchain + higher education" can meet the needs of digital education resources change, traditional teaching mode change and higher education management change, and optimize the education environment. The technology has vast utility in the education sector and can assist in developing additional frameworks with the help of blockchain for example establish the "blockchain + higher education management system" by establishing the "blockchain + higher education management system". Further establish "blockchain + digital certificate authentication platform" to provide authentication particularly for all the educational certificates as well as establish "blockchain + intellectual property protection platform" to resolve copyright disputes. Finally, establish "blockchain + innovation and entrepreneurship service platform" to promote innovation and entrepreneurship so as to realize the internal development of higher education in China.

Keywords: Blockchain technology; higher education; integration development path, Innovation

Introduction:

Education is the core strategy for a nation since it develops generations. Higher education, plays an important part in the education system, is responsible for the major task of cultivating builders and successors with comprehensive development of moral, intellectual, physical and aesthetic, which is related to the successful realization of the goal of building a strong education environment in China. During President Xi Jinping's visit to Tsinghua University, he emphasized that "the need for higher education and the need for scientific knowledge and excellent talents for the development of the Party and the State is more urgent than ever. The new era has put forward new tasks and requirements for the development of higher education, which requires us to use innovative thinking and advanced technology to build an ecological system of higher education with "internal development". When presiding over the 18th collective study of the Central Political Bureau, President Xi Jinping stressed that the integrated application of blockchain technology plays an important role in new technological innovation and industrial change, and emphasized that the application of blockchain in education and other fields should be emphasized and promoted, so as to provide smarter, more convenient and better quality education services to the people. In view of this, importance should be attached to blockchain

With regard to this perspective, we should pay attention to the technical advantages and application prospects of blockchain, actively use blockchain technology to empower higher education, expand the application field of blockchain technology in the development of higher education, so as to create a Chinese solution of "blockchain + higher education", realize the internal development of higher

education in China, and better meet "the needs of higher education for the development of the Party and the state".

1. Interpretation of the concept of "blockchain + higher education"

1.1 Interpretation of "blockchain +" concept

In 1976, Whitefield Diffie and Martin Hellman, experts in cryptography and network security technology, published new directions in cryptography, in which they proposed a new idea of a mutually distributed ledger, which provided an important security theory for blockchain technology. In 2001, the SHA256 algorithm was developed by the National Security Agency (NSA).

In 2008, Satoshi Nakamoto described Bitcoin: A Peer-to-Peer Electronic Cash System in his article "Bitcoin: A Peer-to-Peer Electronic Cash System" as well as described an electronic currency called "Bitcoin" and its algorithm. He also elaborated on the characteristics of blockchain and its working model, which laid a solid foundation for the rapid development of blockchain technology in the future. Blockchain, in short, is a new structured chain by innovating the way of storing, transmitting, and verifying data and information, managing different data in blocks, and stamping them with time stamps.

Blockchain is the underlying core support technology and infrastructure of Bitcoin, and it has important features such as decentralization, openness and transparency, smart contracts, privacy protection, and traceability, which enables blockchain technology to better solve the problems of lack of trust, information asymmetry, and transaction security in the development of sharing economy, and better into the development of sharing economy. Since the birth of Bitcoin, more and more governments, international organizations, enterprises and scholars have started to pay attention to and embrace blockchain technology, and it has been widely promoted and applied in the fields of digital finance, digital currency, financial asset transaction and settlement, supply chain management, data services and so on. At present, application scenarios such as "blockchain + payment", "blockchain + logistics" and "blockchain + government" have started to be implemented on the ground, attracting more and more organizations or enterprises to layout. "Blockchain +", empowering the ecology to open up the imagination of blockchain technology.

The so-called "blockchain +" is the organic integration of blockchain and traditional industries using advanced information technology and blockchain platform to reshape trust relationships and improve industrial efficiency, thus promoting the upgrading and transformation of traditional industries and building industrial blockchain ecology. It should be said that "blockchain +" is the product of blockchain theory and practice development to a certain stage and is expected to become a key element to promote the development of social productivity and the change of production relations.

1.2 The new form of "blockchain + higher education"

In recent years, along with the introduction of blockchain technology into the field of education, "blockchain + higher education" has become an important engine to promote the change of higher education and an important direction and trend of future education development. "Blockchain + higher education" is a new ecology formed by relying on blockchain platform to deeply integrate advanced information technology, computer technology and modern higher education, and promote reform and innovation of higher education. The new form of "blockchain + higher education" has the following main contents and functions: First, data and information level: the collection, recording, storage and sharing of academic data and information by blockchain technology. Second, education transaction level: the smart contract of blockchain can smoothly complete peer-to-peer transactions and automated transactions. Third, education application level: building a perfect higher education system based on blockchain is conducive to improving the utilization rate of higher education resources, and it can ensure the efficient operation of the whole higher education system. Fourth, the level of education system: through the distributed and open technologies of blockchain, a decentralized functional management education system can be created, which is conducive to improving the quality of higher education. In summary, "blockchain + higher education" is a reconstruction of the traditional higher education ecology to establish a new ecology of "student-centered" higher education, and then promote the modernization of higher education governance.

2. The positive effects of "blockchain + higher education" on higher education

2.1 Meeting the needs of digital education resources transformation

With the remarkable achievements of China's digital economy, more and more digital education resources are becoming new elements and new engines driving the development of modern higher education, providing more high-quality teaching resources for teachers and students. However, digital education resources are still in the initial development stage, and there are still problems such as single form, uneven quality, insufficient copyright protection and weak supervision and audit. In view of this, a new circulation model of digital education resources based on blockchain technology can be built with the features of decentralization, openness and transparency, smart contract, privacy protection and traceability of blockchain, which makes this new circulation model more systematic, open and decentralized through the joint operation and collective maintenance of multiple participating subjects. The openness of the new circulation model ensures that all educational organizations, social institutions, teachers and students can participate in the development, management and sharing of digital education resources, thus promoting the self-growth of digital education resources; the decentralization of the new circulation model enhances the independence of digital education resources, thus ensuring the shareability of digital education resources; the smart contract of the new circulation model can well protect The smart contract of the new circulation model can guarantee the rights and interests of both the supply and demand sides, and thus effectively stimulate the creativity of resource providers. It can be said that "blockchain + higher education" can better meet the needs of digital education resources change, so as to continuously improve the quality of higher education.

2.2 Meeting the needs for the changes of traditional teaching mode

Under the traditional teaching mode, not only the teaching activities are restricted by time and space, but also there are problems such as monotonous teaching mode, limited teaching content and backward teaching evaluation, which are not conducive to the improvement of higher education quality. Before classroom teaching, teachers prepare lessons according to the syllabus, while students do not pre-study the knowledge; during classroom teaching, teachers start teaching directly, while students need to be familiar with it for a period of time before they can enter the learning state; after class, teachers assign after-class homework to help students consolidate what they have learned, and assess and evaluate students' knowledge mastery through exams. This traditional teaching mode has been continued for hundreds of years, and its existence has certain necessity and rationality. However, in the face of the development of the times and educational reform, teachers must promptly change their educational philosophy, adhere to the principle of teaching according to students' abilities, and use advanced technological innovation in teaching mode in order to realize "student-centered" personalized teaching and successfully achieve the goal of education and education. By building a higher education teaching platform based on blockchain technology, it is not only possible to manage learning resources, learning process, student records and teaching records, but also to provide students with online learning and game learning through time and space limitations. On the one hand, students can log on the platform to choose their favorite or suitable learning resources and learning methods to carry out independent learning. On the other hand, the platform can track and evaluate students' learning process, analyze the gap between students' knowledge and ability and job positions in real time, give students' scientific knowledge recommendation and career development guidance, and build a new ecology of "learner-centered" education.

2.3 Meeting the needs for changes in higher education management

At present, higher education management generally adopts the governance model of section system, which has the problems of excessive input, low efficiency and poor synergy and is not conducive to the sustainable development of higher education. Therefore, there is a more urgent practical need for higher education management change. In view of this, the features of decentralization, openness and transparency, smart contract, privacy protection and traceability of blockchain technology can be reasonably utilized to build a new model of higher education management based on blockchain technology, so as to make higher education management efficient, open and collaborative, and then provide services for the majority of teachers and students to carry out teaching and research. The decentralization of the new platform can build a diversified evaluation system, which enables multiple subjects such as schools, families, enterprises and social institutions to participate in education evaluation, so that they can diagnose problems in a whole process, in an all-round way and from

multiple perspectives, and thus promote the change of higher education management; the smart contract of the new platform can manage teachers' performance management and title management, students' academic registration management and award evaluation, and schools' asset management and financial management. Intelligent management of teachers' performance management, title management, students' registration management, award evaluation, university's asset management and financial management can improve the quality of higher education management; the new platform's

The openness and transparency of the new platform can promote the synergistic development among different management departments within the university, so as to optimize the allocation of educational resources and help the internal development of higher education.

3. The application of blockchain technology in the field of higher education

3.1 Blockchain digital certificate

Degree certificate, professional qualification certificate, award certificate, etc. are important credentials of students' learning achievements in school. The tamper-evident characteristic of blockchain itself makes blockchain digital certificate a possibility, and the relevant applications are as follows: First, blockchain digital certificate. The Spanish university Carlos III University announced in 2021 that they have successfully delivered their first blockchain-based degree certificates, which can be shared by graduates with any third party through an application. Sunshine College in Fujian Province started developing a digital diploma system centered on blockchain technology as early as 2018, and this kind of graduates can have a traditional paper diploma as well as a digital diploma, thus becoming the first university in China to issue a blockchain diploma. Second, blockchain diploma certification. In order to prevent the "shocking" transaction of fake diplomas, the Ministry of Education of Malaysia launched a blockchain-based system called e-Scroll, which stores the certificate data on the NEM blockchain and provides online verification within seconds by scanning the QR code printed on the diploma. The QR code printed on the degree certificate can be scanned to provide online verification in seconds. Third, blockchain digital certificate. Pioneer Software cooperated with Jiangxi Software Vocational Technology University to launch a blockchain technology-based digital acceptance letter, and issued blockchain technology-based acceptance letters to 2,000 freshly admitted undergraduate students in 2019.

3.2 Blockchain teaching courses

Courses are an important part of higher education, and the relevant applications are as follows: first, blockchain courses. In 2014, blockchain courses were first offered in the United States and the United Kingdom, and then universities in China, such as Tsinghua University, Sichuan University and Xiamen University, have successively offered courses related to blockchain. For example, Zhejiang University set up a course called "Blockchain and Digital Assets" in the fall semester of 2018. This course is a module course for senior undergraduate and graduate students of the School of Computer Science and the School of Software of the university in the direction of "financial technology". The textbook is "Blockchain Technology Advancement and Practice" written and published by Zhejiang University teachers. Second, the blockchain program. In 2014, the University of Nicosia, the largest private university in Cyprus, began offering a master's degree in digital currency. After the first "blockchain engineering" program in 2019 started to enroll in Chengdu University of Information Engineering, there are Dalian University for Nationalities, Hebei College of Finance, Hebei College of Engineering and Technology, Hebei College of Foreign Languages, Shanxi College of Energy, Zhejiang Wanli College, Anhui University of Technology, Anhui University of Engineering, Fuzhou College of Commerce and Industry, Jiangxi University of Science and Technology, Jiangxi College of Engineering, and Jiangxi University of Technology.

Jiangxi Institute of Science and Technology, Jiangxi College of Engineering, Jiangxi Institute of Applied Science and Technology, Qilu University of Technology (Shandong Academy of Science), Chongqing City College of Science and Technology and 14 other universities have newly established "blockchain engineering" undergraduate program. Third, blockchain online courses. Besides offering blockchain majors and offline courses, some universities and institutions have started to try to carry out blockchain online education. For example, FireCoin University has officially launched the "Blockchain Popularization Education Public Welfare Course" together with other blockchain industry and service organizations such as ZhiChain Technology and Chainman International. This public welfare course is open to teachers and students of undergraduate and higher education institutions nationwide for free. The course adopts online learning, online assessment and online ranking, which makes it easy for

universities to arrange their own teaching time. It is hoped that the launch of this public welfare course platform can fill the short board in blockchain general education and accelerate the cultivation of blockchain technology and industrial talents. It is hoped that the launch of this public welfare course platform can fill the shortage of courses in blockchain general education and accelerate the training of blockchain technology and industrial talents.

3.3 Blockchain Education Management

Education management plays an important role in the higher education system, and blockchain technology is gradually solving the pain points of traditional education management, and the relevant applications are as follows: First, blockchain learning ledger. Currently, many universities are trying to use blockchain technology to systematically record students' formal and informal learning processes during their school years, and to keep a complete record of students' learning experiences with digital learning archives. The University of Nicosia stores students' learning experiences such as academic results and awards on a distributed ledger, forming an objective and real learning file; Maribor University in Slovenia records the credits earned by students during their school years through EduCTX. Second, blockchain teaching management. Colleges and universities can build a teaching evaluation system based on blockchain technology to evaluate students qualitatively and quantitatively. Currently, the UK Open University is currently developing and validating a teaching evaluation system based on blockchain technology; Yonsei University and Pohang University of Technology in South Korea will establish an open source knowledge information sharing system and voting questionnaire system based on blockchain technology for students, allowing them to evaluate campus services. Third, blockchain education transactions. Blockchain transactions do not require third-party participation and are a peer-to-peer transaction that ensures the security of the transaction. The University of Nicosia in Cyprus is the first private university in the world to accept bitcoin; the University of Cumbria in the UK is the first public university in the world to accept bitcoin; Curtin University in Australia has launched an innovative cryptocurrency PhD scholarship fund designed by Curtin data scientists that will enable companies and individuals to donate cryptocurrency to fund PhD in blockchain, cybersecurity and data analytics. D. students in blockchain, cybersecurity and data analytics; and the University of Glasgow, UK, which rewards those students who perform best in their courses with a cryptocurrency called Kelvincoin through a blockchain smart contract.

4. Blockchain technology and higher education integration development path

4.1 Establishing "blockchain + higher education management system" to optimize education environment

As we all know, the administrative rigidity of traditional university education management system is serious, which affects the internal development of higher education in China. Therefore, universities should take the initiative to change the concept, correctly understand the positive role of advanced information technology such as blockchain, and build "blockchain + university education management system" to optimize the education environment. Specifically, it can be promoted from the following aspects: First, build a flat "blockchain + administrative management system". The introduction of blockchain technology in the administrative management of universities and the optimization of management procedures by using technologies such as timestamps, smart contracts, consensus mechanisms and distributed ledgers can not only improve efficiency, but also help reduce management costs. For example, financial management involves several departments, which has long cycle time and low efficiency, and consumes a lot of time and energy of teachers and students. If blockchain technology is applied to financial management, the filer only needs to fill in the data block with the project bill number, expense details and other information, and once the pre-set conditions are triggered, the smart contract will be executed automatically after successful verification, and then the financial reimbursement will be completed automatically. Second, to build a smart "blockchain + student management system". As the management of student education involves multiple management departments such as the Student Affairs Office and the college, it is not effective to fill in data repeatedly. In view of this, a permission chain can be established for each management department, and the rules of student management affairs under the responsibility of the department can be transformed into a unified code and uploaded to the "blockchain + student management system", which will be automatically managed according to the smart contract once the pre-set rules are reached.

In addition, if the department does not upload the data in time, the "Blockchain + Student Management System" will alert you according to the smart contract and record the data in order to facilitate

accountability. Third, to build a fair "blockchain + financial aid reward system". In the traditional university financial aid awards, students often tamper with the materials and cause unfair evaluation, which makes it difficult to give full play to the positive effect of financial aid awards. In this regard, we can upload students' data such as student achievement, volunteer service, poverty proof and extracurricular activities to the "blockchain + financial aid reward system", and once students' data reach the corresponding standard of smart contract, they can automatically get the corresponding financial aid reward, which is not only convenient and efficient, but also fair and just. Fourth, the convenience of "blockchain + resource sharing system" is built.

With the implementation of national high-quality online open courses and national vocational education professional teaching resource library projects, a large number of high-quality teaching resources have been accumulated in the field of higher education, but they are not shared in practice. In this regard, the Ministry of Education can take the lead in promoting the construction of "blockchain + resource sharing system" to upload and store these high-quality educational resources, and write private keys and timestamps to improve the sharing rate while protecting the legal rights of educational resources. At the same time, users can also upload problems and suggestions found in the process of use to the "Blockchain + Resource Sharing System", and the original authors can receive relevant information in time to further improve educational resources, thus continuously improving the quality of educational resources.

4.2 Establishing "blockchain + digital certificate authentication platform" to provide authoritative authentication

At present, the certificate management system of higher education, especially academic certificates, has a lot of falsification, which seriously affects the reputation of schools, students' employment and enterprises' recruitment, and brings great trouble to the society, schools and enterprises. Axact, based in Karachi, Pakistan, claims to be the country's largest software export company, but in fact operates the world's largest diploma forgery factory, selling fraudulent diplomas around the world with annual profits of more than \$1 billion. At the same time, certificates are still mainly paper-based and can be easily damaged or lost due to improper storage. Once damaged or lost, the replacement procedure is complicated and cumbersome, which brings a lot of inconvenience to certificate holders. In view of this, it is reasonable to use the outstanding features of blockchain technology to build a verifiable, searchable and traceable "blockchain + digital certificate authentication platform" to ensure that the relevant certificates are safe, reliable, complete and real. Specifically, it can be promoted from the following aspects: First, to provide safe and reliable records of learning and education experiences. Colleges and universities can make accurate and objective dynamic records of students' learning experience data in chronological order and store them in the "blockchain + digital certificate authentication platform" in the form of learning experience blocks, which can not only complete the traceability of students' learning and education experience, but also reduce the recruitment cost of enterprises and enhance the employment tracking ability of colleges and universities. It can also reduce the cost of recruitment and enhance the ability to track graduates' employment.

The University of Nicosia, the largest private university in Cyprus, is one of the first universities in the world to use blockchain technology to record students' learning experience, storing students' learning in a distributed ledger, thus making the learning data record more secure and credible. Second, it provides credible digital certificate authentication. After the completion of the "Blockchain + Digital Certificate Authentication Platform", the digital certificate information will be provided by the education administration department and the school, and the hash algorithm, asymmetric encryption, digital signature and timestamp features of the blockchain will ensure that the digital certificate information is trustworthy and traceable, so that the participating entities can jointly build, maintain and supervise the digital certificate. thereby enhancing the security and trustworthiness of digital certificates and providing credible certificate authentication for society. Singapore's Ngee Ann Polytechnic announced its partnership with blockchain startup Attores to experiment with distributed ledger technology for the issuance of degree certificates. The blockchain can prove the ownership of the digital signature on each degree certificate and provide a tamper-proof mechanism. Even if the degree certificate is eventually tampered with, it cannot be matched with the data stored in the blockchain. In this way, potential employers can rely on the digital certificate key to obtain and verify the authenticity and specific source of job seekers' certificates, eliminating the emergence of resume forgery, which is conducive to reducing corporate recruitment costs and improving the efficiency of talent recruitment.

4.3 Establishing "blockchain + intellectual property protection platform" to solve copyright disputes

Along with the continuous development of higher education, more and more academic papers, teaching videos and teaching courseware are being produced, and these educational resources require a lot of time and effort to create, and the rights holders enjoy intellectual property rights according to the law. At present, with the gradual digitization of educational resources, it is convenient to share them but also leads to the phenomenon of blurred intellectual property rights, which leads to copyright disputes and is not conducive to protecting the legitimate rights and interests of right holders. In view of this, a "blockchain + intellectual property protection platform" can be established to resolve copyright disputes and enhance teachers' enthusiasm to create and share high-quality educational resources. The "blockchain + intellectual property protection platform" has the following functions: First, it reduces the cost of open education resource management. Due to the decentralization feature of "blockchain + intellectual property protection platform", it can build a distributed and open education resource sharing model, which no longer needs to rely on intermediaries but directly adopts peer-to-peer operation to obtain education resources and realize automatic transaction of education resources, effectively reducing the cost of education resource management and helping new form of higher education resource sharing. Second, it optimizes the management of intellectual property rights of education resources. Firstly, blockchain's timestamp and digital signature can determine the intellectual property rights of educational resources, and the right holder cannot modify the educational resources once they are uploaded to the platform, thus preventing the problem of blurred copyright after repeated reprinting, thus providing evidence for the right holder and safeguarding its legitimate rights and interests. Secondly, the traceability, query ability and verifiability of blockchain can easily query and record copyright flow information, which can provide powerful support for rights holders to defend their rights and thus enhance the protection of intellectual property rights.

Finally, the consensus mechanism and smart contract of blockchain can simplify the copyright transaction process. The right holder can set a smart contract when releasing the work, and the user will automatically get the corresponding payment once he uses it, which further enhances the enthusiasm of the creator. Up to now, the copyright registration platform in Guizhou Province has handled a total of about 1.15 million pieces of blockchain certificates of works and more than 280,000 pieces of works registration, covering ethnic folk art, art college graduation design, cultural creation, material design, online classroom, game design, advertising design and other works, which are unanimously recognized by the majority of creators.

4.4 Establishing "blockchain + innovation and entrepreneurship service platform" to promote innovation and entrepreneurship

With Premier Li Keqiang's inclusion of "mass entrepreneurship and innovation" in the government work report, emphasizing that college students are the driving force to promote "mass entrepreneurship and innovation", and the introduction of multiple supporting measures, more and more college students are pursuing entrepreneurship. However, due to the difficulties faced by college students in terms of capital, resources and technology, it is difficult for many college students to successfully carry out innovation and entrepreneurship. In view of this, blockchain technology can be introduced to build a "blockchain + innovation and entrepreneurship service platform" to provide the following support for college students' innovation and entrepreneurship: first, to provide college students with innovation and entrepreneurship resources. At present, many college students have obstacles in accessing innovation and entrepreneurship resources, which to a certain extent affects the smooth development of innovation and entrepreneurship. In this regard, relevant authorities, schools and teachers can upload innovation and entrepreneurship resources to "Blockchain + Innovation and Entrepreneurship Service Platform", so that college students can not only check relevant information through the platform anytime and anywhere, but also find innovation and entrepreneurship projects, courses, videos and other high-quality resources at any time, thus providing resource support for college students' innovation and entrepreneurship.

Second, it provides college students with innovation and entrepreneurship funds. Secondly, it provides innovation and entrepreneurship funds for college students. College students lack capital and it is difficult to raise enough funds for innovation and entrepreneurship. In this regard, the "blockchain + innovation and entrepreneurship service platform", which is open, transparent, honest and reliable, can provide financial support for college students. College students will write their innovation and

entrepreneurship into the blockchain, and universities, enterprises, banks and investment companies can provide financial support through the "blockchain". Universities, enterprises, banks and investment companies can evaluate the innovation and entrepreneurship projects through the "Blockchain + Innovation and Entrepreneurship Service Platform", so as to provide the corresponding innovation and entrepreneurship funds for college students. At the same time, specific contracts can be written into smart contracts, so that investors can not only follow up the process and view the results in real time, but also protect their legal rights and interests and prevent various default problems.

Thirdly, it provides intellectual property security for college students' innovation and entrepreneurship. At present, the innovation and entrepreneurship concept, project and technology concept of college students are often maliciously imitated and copied, which seriously disturbs the smooth development of college students' innovation and entrepreneurship. In this regard, we can make full use of the tamper-evident, traceability and decentralization of blockchain technology to build a "blockchain + innovation and entrepreneurship service platform", write innovation and entrepreneurship ideas, technologies and achievements into the blockchain and upload them to the platform, so as to form data that are traceable, transparent and traceable throughout the process, prevent malicious plagiarism by others, and provide intellectual property security for university students' innovation and entrepreneurship. It can prevent malicious plagiarism and provide intellectual property safety guarantee for university students' innovation and entrepreneurship.

In summary, the integration of blockchain technology and higher education is the rightful meaning of modern education change. We should correctly understand blockchain technology, strengthen the research of "blockchain + higher education", and research blockchain technology that fits the current situation of higher education development in China, so as to strongly promote the internal development of higher education in China and cultivate more high-quality talents for the country. In order to cultivate more high-quality talents for the country, we should strengthen the research on "blockchain + higher education" and research blockchain technology that fits the current situation of higher education development in China.

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