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Construction of College Students' Innovation and Entrepreneurship Education Ecosystem under the Digital Economy

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Abstract: Under the digital economy, college students' innovation and entrepreneurship education is facing new transformation and reform, such as increasing entrepreneurial opportunities, improving quality, and new development opportunities under the digitalization of education. This paper takes the digital economy as the development background, discusses how to build the digital innovation and entrepreneurship education ecosystem, that is, to form an integration mechanism with digital technology as the important content, digital context as the external environment, and digital organizational form as the guarantee. The specific approaches are as follows: Improve the digital skills and ability of entrepreneurs, carry out the design of digital entrepreneurship courses, strengthen the construction of digital organizations, establish a mechanism for multi-subject participation and value co-creation, and constantly promote the development of innovation and entrepreneurship education under the digital economy.

Keywords: Digital economy; Innovation and entrepreneurship; Ecosystem

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1. Introduction

In the context of the advancement of the Fourth Industrial Revolution and the development of the wave of scientific and technological revolution, the digital economy and digital technology have had a profound impact on the training goals and paths of innovative and entrepreneurial talents. Many scholars at home and abroad have conducted research on innovation and entrepreneurship education in the digital economy environment. Well-known scholars such as Zhu and Liu, Jia and Liu, Liu and Zhao, Guo and Yang [1–4], have researched the elements, core, innovation, team, organization and ecosystem of the digital economy, and their research focuses on the entrepreneurial subject, entrepreneurial content, entrepreneurial organization, business model, ecosystem and other contents under the digital economy. The mode and path of entrepreneurship and innovation education in colleges and universities are reflected in many aspects and multiple subjects, involving organizational structure, external environment, curriculum system, and other aspects under the digital economy. Based on the analysis of the new situation of innovation and entrepreneurship under the digital economy, this paper proposes the construction of

an innovation and entrepreneurship education ecosystem and the specific development path under the digital economy.

2. Digital transformation of innovation and entrepreneurship education

2.1. More entrepreneurial opportunities in the digital economy

With the improvement of digital infrastructure and the popularization of digital technology, the proportion of the digital economy in national GDP continues to increase, and digital models continue to innovate. Digital entrepreneurship has become the main choice for college students to find employment and start businesses. The digital economy has reduced the capital cost and transaction cost required for entrepreneurship, and fields such as live streaming, small program development, private domain operation, and content creation have become important paths to attract young entrepreneurs. Xu and Liu believe that the digital economy can promote the income increase of rural low-income groups by expanding the depth and breadth of employment [5]. Yan *et al.* put forward that the digital entrepreneurial economy provides new development opportunities for entrepreneurs [6], who use digital technology and digital platforms to explore entrepreneurial opportunities, such as the development of various software, intelligence, and entrepreneurial opportunities on social media platforms.

2.2. High-quality entrepreneurship in the digital economy

The digital economy provides a path and channel for high-quality entrepreneurship by improving the speed and quality of information transmission, and promoting new business forms and models, such as blockchain, technology, and big data. Wu and Chen proposed that the digital economy can help entrepreneurs to effectively identify entrepreneurial opportunities [7], and make use of the information transparency, low cost, and inclusiveness under the conditions of the digital economy. The higher the quality, technology, and innovation of entrepreneurial opportunities, the higher the income and profits of entrepreneurs. The informatization under the digital economy also reduces the difficulty of financing, eliminates the block of information, enhances the understanding of the project and market control of the angel investors in the investment category, and helps the start-up enterprises to obtain market financing, especially the start-up enterprises with strong science and technology and outstanding strength, the financing difficulty is small, and soon gain the favor and financial support of the investor after entering the market.

2.3. Development of digital education

The first time education digitization was written in the report of the Party Congress was at the 20th Party Congress [8]. The form of education has changed the traditional “teachers teach, students learn” situation, with more flipped classrooms and online platform interaction, to guide students to learn enthusiasm, initiative, and creativity. In terms of educational organizations, the digital economy generates virtual subjects and forms education and teaching networks through social interaction. Online community platforms and digital platforms reduce the search costs, information costs, and bargaining costs of information transmission. For college students’ entrepreneurship education, the organizational form of entrepreneurship education presents a network, platform, borderless integration, breaking organizational boundaries, realizing resource sharing in different departments, regions, and laboratories, and serving college students’ entrepreneurship education and entrepreneurial practice by strengthening communication and information transformation mechanisms.

3. The construction of innovation and entrepreneurship education ecosystem under the digital economy

3.1. The characteristics of the digital economy are endogenous factors that shape the new ecology of innovation and entrepreneurship education

The digital economy has the characteristics of high permeability, platform, data, high additivity, virtuality, and so on. Innovation and entrepreneurship under the digital economy form a process with innovation as the core, based on artificial intelligence, big data, Internet of Things, blockchain, and other technologies, including e-commerce development, unmanned driving, information systems, VR and AI technology, intelligent applications, digital industrialization, and industrial digitalization. The digital economy supports innovative entrepreneurship and achieves high-quality entrepreneurship by improving factor productivity, leveraging digital platforms, and developing high-tech and information technology industries; it creates an innovative platform economy model. Strengthen the benign interaction between online and offline platforms and the organic combination of innovation and entrepreneurship resources, strengthen resource interaction, and improve the efficiency of innovation and entrepreneurship. Liu and Zou proposed that digital technology has changed the traditional entrepreneurial model and formed a good entrepreneurial ecology [9], and the elements of the digital entrepreneurial ecosystem include: Digital multilateral platform, non-platform digital entrepreneurship, digital users, digital infrastructure, formal system, informal system, financing environment, talent environment. Through the network trust mechanism, network sharing mechanism, and multi-party coordination mechanism, the digital ecosystem deepens the interaction between different elements (e.g., capital, technology, talent, etc.), broadens the geographical boundaries of the entrepreneurial ecosystem, and enhances the breadth and depth of entrepreneurial activities.

3.2. Composition of innovation and entrepreneurship education ecosystem under the digital economy

With the transformation of education modernization, digital ecology and education ecology show symbiotic coexistence and synergistic evolution. The innovation and entrepreneurship ecosystem under the digital economy emphasizes the coordinated development of technology core with the participation of multiple subjects, and emphasizes the coordination and utilization of the digital education model, digital context, digital technology, and digital resources. Highlight the open border and resource sharing, emphasize the dynamic mechanism between the subject and the environment, emphasize the integration of digital technology, data elements, and educational resources, form a development force, build a value co-creation mechanism, and open up the ecosystem value chain. Xu and Wu proposed that the digital transformation of education is a systematic development process [10], the core driving force of which is the new generation of digital technology, and technological innovation drives the evolution of the education system to achieve the link and coordinated development of entrepreneurial education subjects, hardware and software, social resources, and digital technology. It is proposed that the transformation of digital education can be realized through the macro level (policy design), the middle level (data-driven), and the micro level (teaching innovation). Teng and Li put forward that digital technology will eliminate entrepreneurial boundaries and broaden group boundaries [11]. Due to the differences in values, social resources, and economic status of different subjects, the effectiveness of digital entrepreneurship education depends on the joint force composition and the effect of digital entrepreneurship education.

Intelligent technology enhances the situational and experiential teaching environment, and students are faced with new development opportunities in virtual and real interaction, multiple interactions, and man-machine collaboration. The development of the digital age is no longer the pursuit of simple knowledge, but

rather creating knowledge for the reality and future. A virtual environment has the learning characteristics of an online scene, data support, personalized customization, immersion experience, and so on. It is interactive, contextualized, and experiential. The "space-time integration" scene constructed by mobile Internet connection breaks through the traditional physical space, especially with the support of AR, VR, MR, and other technologies, forming a multidimensional information system connected by cyberspace, electronic context, and virtual reality.

Organizational boundaries in the digital economy play an important role in reshaping organizational relations and subverting traditional business models. Digital organizational form provides a new organizational system and structure for the innovation and entrepreneurship education concept. Under the digital economy, the organizational structure is flat, flexible, modular, platform-based, dynamic, and other characteristics, emphasizing digitally driven, efficient collaboration and agile cooperation. Guo proposed that new digital technologies and new data elements have promoted the transformation of industrial institutions [12], such as the digital economy driving the platform economy, and the organizational form of digital organizations is flat, flexible, integrated, modular, borderless, dynamic, and other characteristics. Digital organizations complement and symbiosis, and digital platform organizations continue to expand outward, narrowing the boundaries of enterprises and blurring the external form of organizational structure.

Based on the triple helix theory of "government-university-enterprise," Bao proposed an innovation and entrepreneurship education ecosystem in the digital age, highlighting the sharing and application of digital technology and digital resources [13]. Digital technology accelerates the resource complementarity, mutual coordination and collaborative innovation among the three subjects (government-university-enterprises), proposes to give full play to the leading role of the government, universities are in the position of scientific and technological innovation, strengthen the construction of digital infrastructure, introduce intelligent cloud and open learning platform, and promote the coordinated development of the industry. At present, innovation and entrepreneurship education has formed a cooperation mechanism with the participation of multiple subjects, such as the government, social resources and forces, industries, universities, etc., but the relevant cooperation is not in-depth and comprehensive, information communication is not smooth, and the cooperation content is narrow. In the digital economy environment, give full play to the sharing and cooperation advantages of universities and governments under the construction of digital platforms, such as the construction of an information platform for digital enterprises to connect with financing institutions or angel investors, optimize investment projects, play the role of factors, form online evaluation and online investment, and save costs.

4. Digital economy entrepreneurship education development path and strategy

4.1. Establishing entrepreneurship education and training objectives under the digital economy

Digital technology affects the content and form of college students' entrepreneurship education. The current education infrastructure, education platform construction, group interaction, teaching, and practical training environment of colleges and universities depend on the development status of digital technology. From traditional multimedia to new information technology (digital technology) under the education and teaching, such as data computing and storage technology under the university network space, internal and external communication and interconnection under the Internet of Things technology, personalized teaching and management evaluation system under the intelligent technology, immersive technology to help virtual interactive learning, mobile terminal supported smart classroom under the mobile technology.

For college entrepreneurs, the training objectives of digital entrepreneurship education include attaching

importance to college students' innovative thinking, digital awareness, digital literacy, digital behavior and practical ability, digital organization, digital leadership, and digital learning ability. Among them, digital entrepreneurial skills are mainly reflected in the following four aspects. The first level is digital skills and basic applications, such as social media applications, public accounts, apps, e-commerce, and other fields. The second level is the application and future development of digital technology in the industrial field, clarifying the practical application of digital industrialization and industrial digitalization; The third level is the development mode of digital industry, using digital thinking and digital technology to understand the development mode of digital economy; The fourth level can use digital technology, combined with professional technical innovation or product service innovation, is the highest level.

By carrying out special training on digital technology (data acquisition and analysis, network technology, programming, use of new software) and other knowledge, college students can make up for their defects in data acquisition and analysis, mining data value, keeping up with the development of digital technology, and being familiar with the application scenarios of digital technology. The basic digital quality of college students is general, and their professional and technical ability is not strong, which leads to entrepreneurial projects mainly concentrated in e-commerce and other industries with weak skills, resulting in weak specialization and innovation. Therefore, the comprehensive improvement of digital literacy and digital skills has become an important component of college students' entrepreneurial quality.

4.2. Digital entrepreneurship education curriculum and teaching design

At present, most entrepreneurship education follows the traditional education model, and the digital innovation and entrepreneurship education still needs some improvement. Take Carnegie Mellon University as an example. In terms of organizational structure and teaching content, the university has set up the Swartz Entrepreneurship Center, emphasized the cultivation of students' professional ability in digital technology, and launched the "comprehensive art design and technology project," including business courses, professional courses, entrepreneurship and creation courses, innovation courses, product development courses and practical experience components. A portal course, such as Introduction to computing creation practice or information design, is specially provided for students without a design or computer-related professional learning background to help students understand professional knowledge in the computer field. Students can experience the whole process of product design and entrepreneurship in the course plan. Xiao proposed that entrepreneurship education courses can be divided into four categories [14]: General courses, project courses, integration courses and open courses, and built an educational mechanism of multi-subject participation, integration of specialized innovation, integration of theory and practice, integration of both inside and outside the school, and integration of production and innovation.

In the digital economy environment, the model of entrepreneurship education has added new content. The traditional mode of thinking is mainly taught in the classroom, reflecting "innovation," "adventure," "practice," and other contents, while the entrepreneurship education in the digital age takes digital skills, digital applications, digital practices, and digital risks as the main contents. Under the requirements of entrepreneurial quality and ability in the era of digital intelligence, the curriculum system includes: Digital strategy, digital entrepreneurs, digital supply chain, digital enterprise entrepreneurship, digital analysis tools, digital finance, and other content. In the setting of general courses, under the background of the development of the digital economy, the content of digital entrepreneurship education has formed a content system of Internet thinking, e-commerce, and information technology with innovation as the core. With the application of digital economy in production and life, traditional entrepreneurial elements are endowed with digital attributes, and the task

of entrepreneurial education is to train students to have the skills to survive in the rapidly changing market environment to adapt to the uncertain environment. Project courses focus on various entrepreneurship competitions, national innovation plans, incubation practice, industrial cooperation and other contents, promote college students to participate in situational simulation and social practice entrepreneurial activities, and give full play to the advantages of multi-channel main resources; The integration course emphasizes the integration with specialty and practice, industry and course; Open courses emphasize the integration of education and teaching resources through MOOCs and the use of platforms for tracking, big data analysis and open evaluation. Educational models in the digital economy include design thinking, SPOC (Small Private Online Course), TRIZ (Theory of Inventive Problem Solving), etc.

4.3. Organizational construction of entrepreneurship education under the digital economy

Taking American universities as an example, Huang and Zhang explained that to promote the circulation and sharing of organizational resources for entrepreneurship education in the whole university [15], Stanford University established the Entrepreneurship Research Center, and relied on the entrepreneurship network platform of entrepreneurship education to integrate various resources such as colleges, interdisciplinary projects, research centers and laboratories. The implementation of the organizational system requires the construction of a platform, the elimination of geographical barriers and resource dispersion barriers, the establishment of a leading group, the establishment of development goals, the promotion of an open and flexible organization, the use of powerful multi-party resources, to provide resources and suggestions for college students' innovation and entrepreneurship, and the formation of powerful guidance.

The digital economy promotes the organizational changes of entrepreneurship education through the following ways: First, the establishment of a sharing platform for information and resources, the formation of a dedicated digital guidance and management service department for innovation and entrepreneurship, unified planning, management, organization and coordination, to ensure efficient cooperation among various departments on campus, and to realize the flow and sharing of knowledge, information, talents, resources and other elements among multiple subjects. The more entrepreneurial elements within a digital organization, the closer the communication and connection between each other, the more prosperous the digital entrepreneurial activity. Through the screening and configuration of entrepreneurial factors, the digital multi-agents take the needs of digital users as the core, connect the heterogeneous factors of each agent, and realize the coupling of factors. And recruit skilled digital technology and information technology personnel to manage. Taking Stanford University as an example, based on the organization of resource sharing and circulation in Entrepreneurship education, the Stanford Entrepreneurship Network was founded to serve entrepreneurial projects and form a digital innovation and entrepreneurship service platform. Including website, public account, course platform, contest management system, etc., to provide strong network support for digital innovation and entrepreneurship education, comprehensive digital application of innovation and entrepreneurship information content, such as the website by multiple subjects to provide resources and participation, to achieve information resource coordination, set up relevant functional modules. Such as an interactive communication module, a course construction module, an entrepreneurial project display module, alumni resources, and so on. The digital innovation and entrepreneurship competition system provides registration channels for college students, project management and display, investment promotion, entrepreneur support, contest mentor library, and other columns, helping all kinds of entrepreneurship competitions to steadily advance and efficiently use resources. In the course section, an online learning system is set up to provide various digital teaching resources and auxiliary resources, communication platforms, and forums to mobilize students' learning enthusiasm.

4.4. Constructing an innovation and entrepreneurship education evaluation system featuring student-centered and human-machine coordination

The differences between the evaluation system of innovation and entrepreneurship education under the digital economy and the traditional education evaluation system are mainly reflected in the following aspects: The degree of digital technology, more attention to effectiveness and output, personalized training, and the man-machine collaboration mode. The evaluation system of innovation and entrepreneurship education should fully stimulate the participation of multiple evaluation subjects (universities, governments, enterprises, social groups, etc.), use text recognition, image recognition, speech recognition and other technologies to read traditional media information, and strengthen automatic data collection and analysis; Using big data technology to collect process learning data; Artificial intelligence technology is used to create simulation environment, virtual task scene, collaborative environment, etc., to test students' problem-solving ability in real task situations. Fully demonstrate students' knowledge structure, ability performance, and inner potential, and provide a detailed "digital portrait" for each student; Build a distributed learning profile (coupling decentralized data via the Internet) that certifies students' diverse learning outcomes. Intelligent technology is used to collect and analyze college students' learning time, learning habits, learning styles, learning methods, and other personal information. On this basis, personalized evaluation programs and visual feedback reports are formulated.

4.5. Digital multi-subject value co-creation under continuous improvement

In the digital economy environment, an innovative development mode with digital technology as the core should be opened, resource sharing and platform-based value co-creation path should be highlighted, online and offline education resources should be gathered, and new education situations in the virtual environment should be set up, and industrial collaboration and cross-border integration should play a role in the output efficiency of innovation and entrepreneurship education. Centering on the industrial chain, integrating the data chain, connecting the innovation chain, activating the capital chain, and cultivating the talent chain, giving full play to the role of sharing education information resources and integrating resources, it is easy to form economies of scale and innovation effects, and form a multiplier effect of resource utilization. We will combine research and development, incubation centers, practice platforms, and social industries to build an ecosystem of collaborative innovation. Du *et al.* proposed that digital entrepreneurs make use of network resources and social capital in the ecosystem to form entrepreneurial opportunities [16]; In digital entrepreneurship opportunities, cross-field and cross-level cooperation has increased. The digital economy provides a platform for the coordinated development of multiple entities, establishes a communication mechanism and a sharing mechanism, such as the construction of the basic layer (website, public account, application software and technology development, etc.), the data layer (capital resource data, education resource data, industrial information data, policy data), and the realization of the goal layer (value creation). Build a technology research and development cooperation platform, an education resource sharing platform, an industrial information cooperation platform, a venture capital cooperation platform, a human resources exchange platform, etc., to achieve the participation and sharing of multiple subjects.

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