Research on the Integrated Development Mode of New Engineering Disciplines and New Liberal Arts in Colleges and Universities based on Artificial Intelligence Technology

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Abstract: [Purpose/Significance] With the continuous breakthrough and wide application of information technology, education is moving towards informatization, digitization and intellectualization. This paper analyzes and studies how to grasp the new challenges and opportunities brought by the new generation of information technology with artificial intelligence as the core, and innovate the fresh ideas and ways of the construction of new engineering disciplines and new liberal arts in colleges and universities. [Method/Process] The case study method and literature survey method are mainly used to analyze and summarize the research and practice progress of new generation of information technology based on artificial intelligence in the field of education at home and abroad in recent years. On this basis, this paper constructs the general idea and framework of the research on the integrated development mode of new engineering disciplines and new liberal arts based on artificial intelligence technology. [Results/Conclusions] The personalized and adaptive learning mechanism of artificial intelligence, AR /VR virtual simulation technology and big data intelligence technology are applied to the application practice research of college curriculum system design, teaching mode reform and practical education innovation. The research results can play a certain reference value for private colleges and universities to accelerate the construction and development of new engineering disciplines and new liberal arts.

1. Introduction

The integration of new generation of information technologies such as artificial intelligence, multimedia intelligence, big data mining, Cloud Computing and higher education technology has promoted the new normal and new model of higher education development of “new engineering”, “new liberal arts”, “new agriculture” and “new medicine”. Its prominent feature is the diversification, learning, personalization and modernization of higher education. Especially during the epidemic period, the combination of online and offline education informatization, digitization and intelligence has rapidly become the general trend of the development of higher education in the world. Educational informatization, digitization and intellectualization are supported by artificial intelligence, big data processing, Internet of Things, Cloud Computing and other technologies, and are mainly characterized by smart classroom, virtual simulation and multimedia intelligence, which are a new stage of the development of educational informatization. Chinese President Xi emphasized in his congratulatory letter to the International Conference on Artificial Intelligence and Education held in 2019 “Actively promote the in-depth integration of artificial intelligence and education, promote educational reform and innovation, give full play to the advantages of artificial intelligence, and accelerate the development of education accompanying everyone’s life, education for everyone equally, education suitable for everyone, and more open and flexible education” In

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November 2020, director Wu Yan of the Ministry of Education pointed out at the National Conference on the Construction of New Liberal Arts that there is no way for education to deal with the new changes in higher education except active innovation. Zhong Binglin and other experts pointed out that AI technology provides the source of innovation for colleges and universities and promotes the cross integration of AI technology with mathematics, computer science, physics, biology and social sciences[1]. Zhang Jinjie pointed out that the construction of "new engineering" and "new liberal arts" have distinct commonalities: firstly, in terms of construction objectives, closely follow the needs of national development, actively adapt to the new requirements put forward by the new round of scientific and technological revolution and industrial reform, and better serve social and economic development; secondly, pay attention to cross integration in the development path, break down the barriers of professional division, promote the cross integration of disciplines, and inject strong driving force and development aftereffect into the construction of traditional disciplines and majors; thirdly, in terms of talent training, we should highlight the characteristics of compounding, application and innovation, so as to better meet future challenges[2]. Yuan Qing and other experts believe that by building a new interdisciplinary curriculum group to cultivate students' unique knowledge vision and ways of thinking across disciplinary boundaries, and exploring and solving new social problems from an interdisciplinary perspective, this new training mode will bring up compound high-level talents with good humanistic quality and innovation ability[3]. As a private college focusing on liberal arts, it is more necessary to recognize the new situation of the development of higher education, grasp the new opportunities brought by the scientific and technological revolution and industrial revolution, and innovate new ideas and new ways of school running and development.

2. The new generation of information technology with artificial intelligence technology as the core leads the reform and innovation of higher education

Countries all over the world attach great importance to the development of artificial intelligence. The United States, Japan and European countries have raised the research of artificial intelligence to the national strategic level. In July 2017, the State Council issued the Development Planning for a New Generation of Artificial Intelligence, which clearly pointed out that the rapid development of artificial intelligence will profoundly change human social life and the world in profound ways[4]. The national education department pays more attention to the guidance of a new generation of information technology with artificial intelligence and big data as the core, and promotes the reform of traditional education mode. The Ministry of Education clearly pointed out in the Guidance on Deepening the Reform of Education and Teaching in Universities and Colleges Affiliated to Central Departments issued in 2016 and the Education Informatization 2.0 Action Plan issued in 2018 that we should make full use of AI technology, big data, Internet plus and AR/VR technology to promote the "mixed teaching reform of online and offline of interschool and intraschool", the new talent training model to solve the bottleneck problem of education and teaching, educational service supply mode and new mode of educational governance[5]. The development direction of the new generation of artificial intelligence can be divided into big data intelligence,crowd intelligence, cross-media intelligence, hybrid-augmented intelligence and autonomous intelligence[6]. In The Action Plan for Artificial Intelligence Innovation in Colleges and Universities, the Ministry of education clearly puts forward that colleges and universities should improve the artificial intelligence education system, build artificial intelligence disciplines and promote the construction of "new engineering"[7].

At the same time, in May 2012, Harvard University and MIT announced that EDX, an online education platform, was free to the whole world, whose emergence broke the wall of the world's universities[8]. Online education courses not only provide a free learning platform, but also bring big data of teaching resources. Data driven big data intelligent technology represented by deep learning is rapidly and profoundly changing our way of learning, thinking and problem solving. How to mine challenging scientific problems from big data and promote scientific discovery based on data-driven intelligence is not only the key content of new engineering and new liberal arts

education, but also an important support for promoting the development of new interdisciplinary and the integrated development of new engineering and new liberal arts. The integration of artificial intelligence and big data technology in higher education challenges the traditional education system from multiple levels[9]. Using modern information technologies such as big data to carry out teaching knowledge management in colleges and universities will help to explore teaching knowledge and improve teaching efficiency, and promote educational modernization[10]. In particular, how to use the new generation of information technology to cultivate college students' innovative ability has become a problem for many colleges and universities. The weak innovation atmosphere and the lack of innovative software and hardware environment are also an obstacle for college students to cultivate their innovation ability. This requires us to take advantage of leading college students to approach the key problems to be solved by enterprises and society, create a collaborative innovation atmosphere, cultivate innovative thinking, maximize the potential of students, and adopt more Participatory Teaching in teaching, combine the latest academic research results, cases and experiments with the classroom[11]. Good project / platform organization scheme can provide diversified, creative and adaptive environmental spaceand new solutions of timely insight into external needs and timely transformation to realize interdisciplinary research[12]. Therefore, the construction of new engineering and new liberal arts with artificial intelligence, big data processing and other new generation information technology as the core will have a great impact on the curriculum system, educational methods and practice setting of traditional education, and then lead the development of modern education towards networking, digitalization and intellectualization.

3. Connotation and characteristics of new engineering and new liberal arts education

The construction of "new engineering" will meet the needs of the fourth industrial revolution and strengthen the cultivation of strategic talents; the construction of "new liberal arts" is based on the cross integration with the new scientific and technological revolution to improve the connotation construction of traditional liberal arts majors. The cross integration of the two is bound to revitalize undergraduate education and improve the quality of talent training.

3.1. Connotation and characteristics of new engineering education

In the reform and development of higher education in the new era, China emphasizes that the "new engineering" must play a pioneering role in leading the "four new" construction. The connotation of new engineering education is to emphasize the practicability, intersection and integration of disciplines, and pay attention to cultivating interdisciplinary innovative and compound talents; Its characteristic is that the "new engineering" education should not only serve the upgrading of traditional engineering education in colleges and universities, but also serve the emerging industries in the society.

3.2. The connotation and characteristics of the new liberal arts

The connotation of the new liberal arts is based on the cross-fertilization with the new science and technology revolution, which greatly expands its extension and scope, including not only the basic liberal arts of literature, history and philosophy, but also the applied liberal arts of economics, management, law, education and art. There is an urgent need for the technology of the new engineering to break through the thinking of "small liberal arts", build the vision of "large liberal arts" and improve the connotation construction of the traditional liberal arts specialty. It is characterized by the intersection of literature and science, i.e., integrating modern information technology into philosophy, literature, language and other such courses to provide students with comprehensive interdisciplinary learning and to achieve knowledge expansion and cultivation of innovative thinking.

3.3. Status quo and development opportunities of private colleges and universities

It is an important guarantee for the stable and orderly development of private colleges and

universities to have a teaching team with excellent political quality, strong professional quality and reasonable age and title structure[13]. At present, most of the full-time teachers in private colleges and universities have master's degrees, and they started their academic careers in a hurry right after graduation. The reserve of knowledge and practical ability is not enough to support them quickly and firmly on the podium; they have not received systematic and in-depth training in scientific research methods. The accumulation of subject expertise is not enough, and the ability to independently carry out high-level academic research is not enough, and the accumulation of teaching, scientific research and social services is obviously insufficient[14]. As a result, private colleges and universities are generally faced with problems such as insufficient resource investment and difficulty in introducing high-end talents in the development of disciplines, professional construction and personnel training. According to statistics, almost all private colleges and universities in Jilin Province have no academic doctoral and master programs, and very few colleges and universities have doctoral and master's professional disciplines program. Due to the lack of discipline guidance and driving effect, engineering generally has problems such as unclear characteristics and lack of competitiveness, especially the engineering majors in liberal arts colleges are facing severe challenges. The development of new engineering and new liberal arts has brought great opportunities for the development of both disciplines. Therefore, it is of great theoretical significance and application value to improve the characteristics of new engineering and the innovation of new liberal arts to break the discipline barriers, use modern information technologies such as artificial intelligence and big data processing, organically integrate the new engineering and the new liberal arts, better unify the quantitative methods of science and engineering with the qualitative methods of liberal arts, innovate the educational organization mode, and build a systematic talent training system.

4. Research and practice on the integrated development mode of new engineering and new liberal arts based on artificial intelligence technology

The construction of "new engineering" and "new liberal arts" contains new ideas, new logic and new models. The integrated development of the two will certainly promote the reconstruction of discipline and specialty construction relationship and the improvement of talent training quality. Cross integration is implemented in the design of curriculum system and the reform of teaching mode, which is not only the cross integration of curriculum content, but also involves the communication and interaction between teachers; the practical education innovation of learning for practice is the new way engendered by cross integration to solve the practical problems. For one thing, in practical teaching, we should pay attention to understanding industrial needs, using social resources to serve teaching, improving curriculum design methods, learning from each other, developing strengths and avoiding weaknesses, encouraging interdisciplinary integration, mutual penetration and concealing weaknesses, so as to serve the construction of characteristic majors; for another, taking the multi-disciplinary open and innovative laboratory as the supporting platform, integrate the discipline competition into the students' practical teaching system, stimulate the students' motivation for learning professional courses, enhance learning autonomy, strengthen the improvement of students' professional practical innovation ability by discipline competition, and form a teaching system curriculum integrating teaching, practice and competition.

4.1. Framework of integrated development model of new engineering and new liberal arts education based on artificial intelligence technology

The general idea of this research: Based on artificial intelligence, multimedia intelligence and big data mining technology, integrate curriculum construction, discipline construction, scientific research and the integration of industry and education into the construction of new engineering and new liberal arts; using the thinking of new engineering to improve the traditional liberal arts to realize the innovative development of new liberal arts, and integrating the concept of new liberal arts into new engineering to realize the characteristic development of new engineering; Through the cross-integration form of new engineering and new liberal arts, we will build interdisciplinary and

inter-professional curriculum system construction, teaching model reform and practical education innovation of the integration of liberal arts, engineering and science, and engineering and liberal arts, and explore new engineering and innovation in private colleges and universities so as to lay a foundation for the construction of interdiscipline and the cultivation of compound innovative applied talents withall around development of moral, intellectual, physical, aesthetics and labor education.The framework of the integrated development mode of new engineering and new liberal arts education based on artificial intelligence technology is shown in Figure 1:

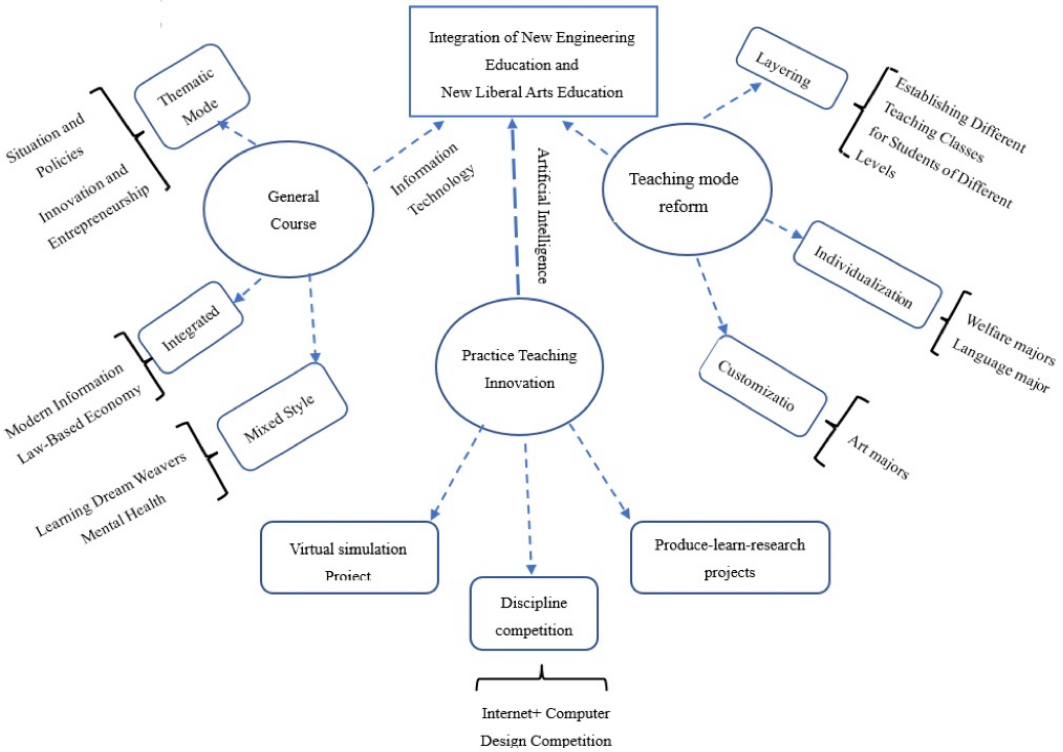

Figure 1 Framework of Integrated Development Model of New Engineering and New Liberal Arts Education Based on Artificial Intelligence Technology

4.2. Application and practice of artificial intelligence technology in the research on the integrated development mode of new engineering and new liberal arts education

A preliminary practical work has been carried out on the framework of the integrated development model of new engineering and new liberal arts education based on artificial intelligence technology.

1) Design of general education curriculum system through the characteristic development of new engineering and the innovative development concept of new liberal arts

In the formulation of the curriculum system of the new talent training program of our university, different kinds of courses are set up in the general elective courses shared by arts and science majors: special courses integrating the forms and policies of the new generation of information technology and the foundation of College Students' innovation and entrepreneurship. Modern information technology, legal economy and other integrated courses that embody the integration of Arts and Sciences and the intersection of liberal arts, as well as the hybrid courses of online and offline combined learning, dream building and psychological education for College Students. The change of this design system requires teachers to reorganize and design the teaching content, and to focus on increasing the current cutting-edge, basic and comprehensive content suitable for the development of new engineering and new liberal arts, which is beneficial to students of different disciplines and majors.

2) Teaching mode and method reform based on artificial intelligence concept and technology

In the era of artificial intelligence, the teaching mode from teacher-centered to student-centered is constantly impacting the traditional teaching mode. Both new engineering and new liberal arts

education advocate wisdom education. Therefore, for one thing, our school promotes intellectualization of educational means, that is, we use advanced information technology to build smart classrooms, arrange "first-class courses" and experts and professors to teach in smart classrooms, optimize teaching methods, stimulate students' interest in learning and improve teachers' teaching quality; for another, the educational content reflects the student-centered, personalized and adaptive learning mechanism based on artificial intelligence, and tries a new hierarchical, personalized and customized intelligent teaching model. For example, facing the current situation of poor foreign language foundation of private school students, we adopt hierarchical English teaching methods and build personalized teaching modules for students at different levels; in view of the characteristics of students' poor foreign language foundation and concentrated professional courses in School of Music and Dance of our university, we have tried out customized English teaching, and implemented a mixed teaching chain of paying attention to the mastery of basic knowledge, strengthening practice, review, self-study and comprehensive phased achievement test, in which offline is mainly used and online is supplemented.

The practical application results show that: using multimedia intelligent equipment to assist the educational process, based on the personalized and adaptive learning mechanism of artificial intelligence, and according to the basic state and training objectives of students and students' individual needs, interest and ability, optimizing teaching and customizing personalized hierarchical teaching can guide different students into different levels and fields and achieve twice the result with half of the effort.

3) Practical teaching innovation of interdisciplinary integration by using artificial intelligence technology

The diversification and intellectualization of educational models are not only reflected in theoretical teaching, but also integrated into practical teaching. In terms of practical education innovation of learning for application, our university has constructed an interdisciplinary cross integration platform applying artificial intelligence thinking and technology, carried out experiential teaching based on virtual simulation experiment platform, open teaching integrated into college students' discipline competition activities, and collaborative practical innovation combining IUR with the education project.

(1) In experiential practical teaching. The Environmental Design of CollegeofArtandDesignand the Automobile Service Engineering, Electrical Engineering and Automation, Electronic Information Science and Technology of the Institute of Technology use the virtual simulation experiment platform to carry out the virtual simulation experiment driven by the project, which provides an intelligent learning and practice environment for each student, greatly improves the innovative thinking and interaction capability of teachers and students, and has made gratifying achievements. In 2019, the project of New Energy Vehicle Power System Cognition and Operation Observation and Virtual Simulation Teaching Application Practice in Digital Space Environment was rated as the first-class curriculum project of virtual simulation experiment teaching in Jilin Province. The interdisciplinary research team formed by the Music and Dance Arts Laboratory, from the perspective of personnel training in colleges and universities, carried out research on art therapy project by integrating psychology, medicine and pedagogy combined with the characteristics and advantages of Music and Dance Major, which has achieved gratifying results.

(2) In the open practical teaching. The open practical teaching system is established by integrating subject competition into the course design and other practical teaching. In recent years, the school has paid attention to the combination of theory and practice in practical teaching, actively encouraged students to participate in various discipline competitions, and especially advocated interdisciplinary joint participation in competitions; facing the market demand, the principle of promoting teaching and learning through competition is upheld to encourage students to transform the knowledge and technology learned in class into the ability to solve practical and complex problems; It cultivates their innovation and entrepreneurship ability and sense of teamwork, and explores and practices new ways to cultivate applied talents with the cross integration of science students and engineering students, liberal arts students and liberal arts and science students. With

this system, students will make new breakthroughs in the winning programs of College Students' "Internet+" Innovation and Entrepreneurship Competition and Computer Design Contest. In 2021, the number of entries in our school for The 7th College Students' "Internet+" Innovation and Entrepreneurship Competition in Jilin was 92% higher than that in 2020, the number of participants increased by 98% over 2020 and the number of provincial awards increased by 117% compared with that in 2020. See figure 2 and figure 3.

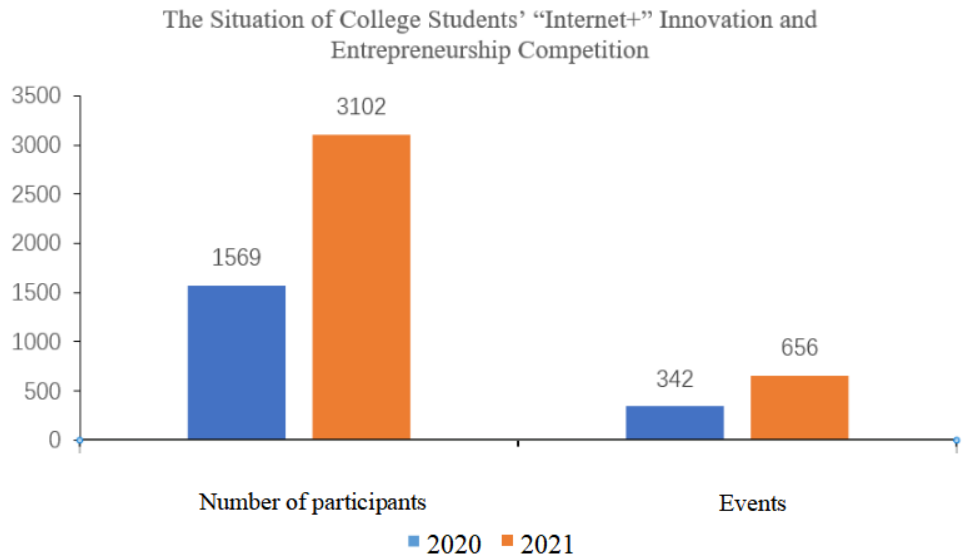

Figure 2 Comparison of Awards of College Students' "Internet+" Innovation and Entrepreneurship Competition between 2020 and 2021

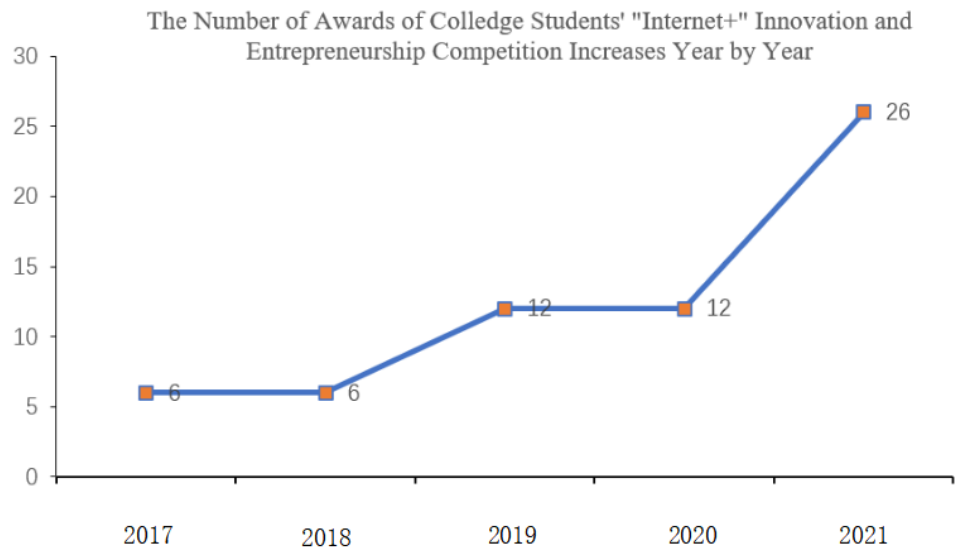

Figure 3 Comparison of Awards of College Students' "Internet+" Innovation and Entrepreneurship Competition from 2017 to 2021

(3) In cooperative practical teaching. The practical teaching integrated with national IUR collaborative education project stimulates teachers and enterprises to strive to make technological breakthrough according to scientific issues and actual needs. Then, with the combination of innovative theoretical knowledge and practical application, we can tap the potential of students' active learning and cultivate students' ability of engineering practice. The development thinking of cross integration of new engineering and new liberal arts and the means of combining with practical teaching has expanded the vision of teachers and has promoted the collaborative education project of IUR of our university to a new level. In the four years from 2016 to 2019, our university has been approved of 9 collaborative education projects of IUR of the Ministry of Education, while 26

collaborative education projects of IUR of the Ministry of Education in 2020. At the same time, the cross-integration projects of new engineering and new liberal arts are increasing, and there are 15 fusion discipline projects in 2020 alone (Figure 4, Table 1)

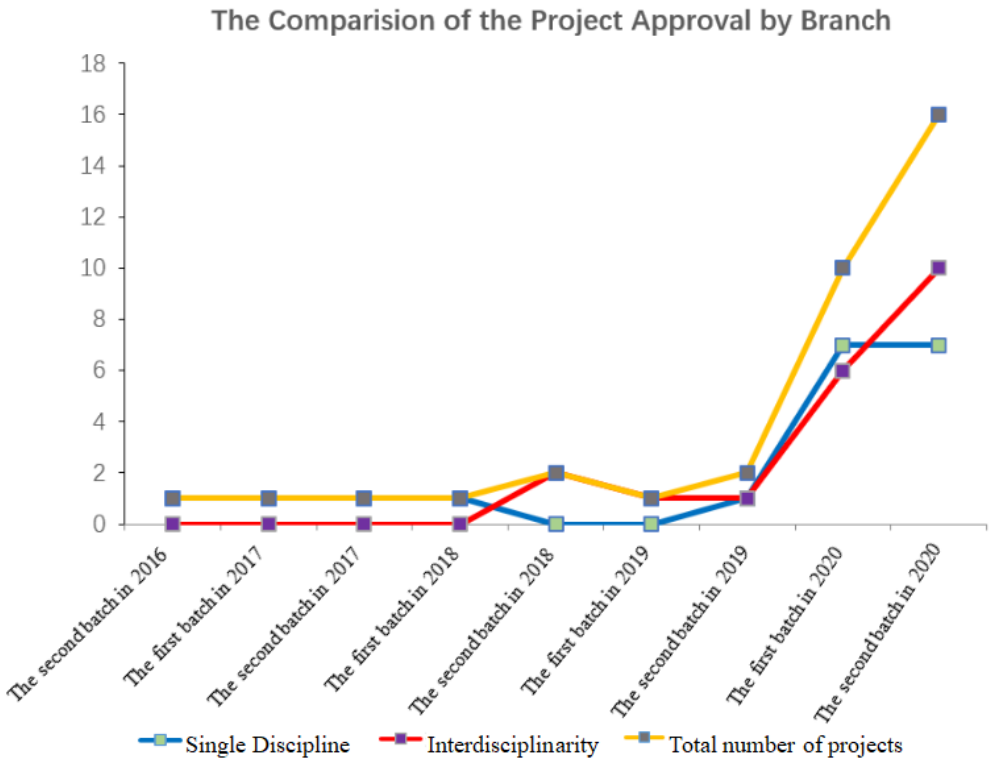

Figure 4 The situation of collaborative education projects of industry-university of the Ministry of Education from 2016 to 2020

Table 1 The Project Approval of Industry-university Collaborative Education Project in 2020

Serial Number	Project Type	Project Name
1	Construction of new engineering, new medical, new agriculture, new liberal arts	Construction of application-oriented IT talents training system in university*
2	Construction of new engineering, new medical, new agriculture, new liberal arts	Research on development and construction based on blockchain*
3	Reform of teaching content and curriculum system	Construction of Innovation and Entrepreneurship Training online and offline mixed outstanding courses based on “one flat and three ends”*
4	Reform of teaching content and curriculum system	Reform of the training mode of IT professionals under the background of new engineering
5	Reform of teaching content and curriculum system	Research on the reform and construction of cross-border e-commerce training courses for Business Administration majors*
6	Reform of teaching content and curriculum system	Elderly care’s cluster construction and cooperation with school-run enterprise
7	Reform of teaching content and curriculum system	Construction of cross-border e-commerce simulation training demonstration course based on entrepreneurship education*
8	Teacher training	Exploration on the development path of college English teachers under the guidance of “College English Teaching Guide” (2020 Edition)
9	Practical conditions and	Construction of innovation and entrepreneurship

	construction of practice base	practice teaching platform based on virtual simulation competition*
10	Innovation and entrepreneurship education reform	Exploration and practice of innovation and entrepreneurship-oriented talent training model
11	Construction projects of new engineering, new medical, new agriculture, new liberal arts	Research and practice on the construction of innovative platform for all-media talent training under the background of industry-university cooperation*
12	Reform projects of teaching content and curriculum system	Reform of project management curriculum system in applied undergraduate universities
13	Reform projects of teaching content and curriculum system	The application of PBL teaching method in the reform of marketing curriculum under the background of Internet+*
14	Practical conditions and practice base construction projects	Construction of e-commerce practice teaching platform based on virtual simulation*
15	Practical conditions and practice base construction projects	Construction of practical conditions for human resource management for business administration majors
16	Innovation and entrepreneurship education reform project	College students' e-commerce poverty alleviation and entrepreneurship project based on "Live E-commerce" *
17	Teacher training	Cultivation and improvement of art teachers' comprehensive ability under the framework of school-enterprise cooperation
18	Reform projects of teaching content and curriculum system	Innovation and entrepreneurship education reform under the collaborative innovation model
19	Reform projects of teaching content and curriculum system	The application of English thinking training in business English audio-visual courses
20	Teacher training program	Research on e-commerce teacher training ideas under the background of live marketing*
21	Teacher training program	Research on the construction of social e-commerce teachers
22	Practical conditions and practice base construction projects	Construction of experimental project of traditional pharmaceutical technology based on virtual reality*
23	Practical conditions and practice base construction projects	Construction of open virtual simulation experiment project of traditional pharmaceutical technology*
24	Practical conditions and practice base construction projects	Construction of business-finance integration practice base*
25	Reform projects of teaching content and curriculum system	Research on the development and application of virtual reality technology in the teaching of traditional Chinese medicine—Taking "heart palpitations" in internal medicine of traditional Chinese medicine as an example*
26	Reform projects of teaching content and curriculum system	Innovation and practice of international modules of Internet + Aged Care Courses*

Remarks: * is an interdisciplinary integration project

5. Conclusion

The "Four New" construction is accelerating the connotative development of higher education. The new generation of information technology with artificial intelligence and big data technology as the core will play a leading and promoting role in realizing the connotative development of higher education. In order to effectively promote the construction of new engineering and new liberal arts, the characteristic development of new engineering and the innovative development of new liberal arts are the key to the construction. This paper focuses on the three links of curriculum system setting, teaching mode reform and practical education innovation, and from the three aspects

of AI Enabling Education, professional technology education and practical application education, it puts forward the general idea and framework of the integrated development of new engineering and new liberal arts education led by the new generation of information technology, and makes a preliminary practical verification, which can play an important reference value for promoting the deep integration of information technologies such as new engineering, new liberal arts education and artificial intelligence, and then accelerating the construction and development of new engineering and new liberal arts.

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