EXPLORATION OF BIG DATA TALENTS UNDER THE CONCEPT OF CDIO

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ABSTRACT

As an educational idea guiding the reform of engineering education personnel training mode, CDIO education mode focuses on the cultivation of students' system engineering technical ability, especially the ability of project conception, design, development and implementation, which is widely used in the training of engineering professionals. In this paper, Outcomes-Based Education (OBE)-CDIO engineering education mode for engineering certification is introduced, and blending education is led into all aspects of engineering personnel training. Taking the talent training of big data engineering as an example, guided by the talent ability training, under the blending education and CDIO Engineering Education Concept, the paper explores the guidance and practice scheme of the goal of talent training, graduation requirements, the integrated curriculum system of blending learning, the project system of integration of industry and education, the integrated extracurricular practice system of the centralized guidance of tutors, the quality education system combining counsellors and professional teachers. In the process of implementation and exploration of mixed education, the paper takes the project of 'data acquisition and preprocessing practice' as an example to analyze the design of courses, the construction and use of resources. Through exploration and practice, the paper expounds the innovative research and practice of engineering personnel training, which is the combination of blending education and OBE-CDIO education mode.

KEYWORDS

OBE-CDIO, Blending Education, Big Data Engineering Talents, Training Mode, TOPCARES-CDIO, Integration of Industry and Education

INTRODUCTION

With a new round of technological revolution and the industrial revolution, as well as the boom in the new economy worldwide, higher requirements have been raised for engineering talents cultivation in the new era (Kang, Lu, & Xiong, 2008). To meet the needs of the times and society, it has become an important method for the cultivation of professional talents in China's universities to reform the education mode and create online and offline learning environment for engineering students in the internet. Among them, CDIO represents the concept, design, implementation and operation (Bankel et al., 2003), which gradually attracts the attention of the education field, and constructs the ability to smoothly link theory and practice under the guidance of this concept.

In the process of talent cultivation, we should follow the human-oriented consciousness, take CDIO Engineering Education Concept as the guidance, and combine the ideas of Outcomes-

based Education (OBE) (Fu, Huay, & He, 2017). OBE is an educational concept proposed by American scholars, which is significantly different from the traditional content-based teaching concept (Zhou, Liu, & Yao, 2016). OBE based teaching uses outcomes-based teaching concept. The purpose of teaching is to make graduates meet certain ability requirements. The teaching plan should reflect the support for the graduation requirements. The teaching link is to effectively complete the corresponding "support" tasks and assess whether the graduation requirements are achieved item by item. OBE-CDIO is an innovative model of training engineering talents.

With the advent of mobile Internet, the traditional teaching model of higher education has also been greatly impacted (Bai, Xie, & Li, 2017). In traditional classroom teaching, students learn in a single, passive and uninteresting way. Also, there is a lack of interaction between teachers and students, and students' learning is always in a passive state (Zhou, Zhu, & Liu, 2018). The popular blending education mode can effectively integrate MOOC (mass open online courses) (Breslow et al., 2013), SPOC (small private online courses) and physical classroom, give full play to their advantages and realize complementarity. It advocates the cultivation of students' initiative, enthusiasm and creative learning concept, which has an important guiding significance for the cultivation of innovative talents under the background of engineering education.

However, the impact of the business value of different professionals on the social economy is quite different. Therefore, in addition to the great changes in the concept and mode of talent training, the changes in educational methodology are also related to the development of the major, the needs of talents and the requirements of ability. Nowadays, massive data resources are generated based on production and life. The digital level of the whole economy and society will follow the evolution route of "data information digital intelligent". The training of big data talents is a prerequisite for the development of the digital economy. Big data talents is engaged in the core technology-related work of big data, mainly including the core talents of research, development and analysis, and the compound talents with both industry background and big data skills.

According to relevant research statistics, by the end of the year 2018, the number of core talents of big data in China was 2 million, with a gap of 600 thousand. To deal with the shortage of big data talents, it is necessary to speed up the establishment of data science and big data technology and other related majors, and cultivate a group of compound talents with professional knowledge and big data technology, which is also the development trend of big data talents training in the future.

Based on this, we should promote the training of data science and big data technology talents with the aid of the education mode of international engineering education professional certification standard. At the same time, in combination with the development status and industrial demand of regional and big data-related industries, based on the integration and collaborative development of industry and education, the implementation of industry, school and enterprise linkage, professional teachers and enterprise personnel mutual employment, mutual assistance and joint mechanism, we explore the integrated curriculum system of training objectives, graduation requirements and blending teaching under the concept of OBE-CDIO, build the integrated extracurricular practice system guided by tutors, and the quality education system combined by the instructor and professional teachers, form the teaching mode with student-centred and learning achievement-oriented, to achieve the ability improvement of big data students.

Exploration of Big Data Talents Training under OBE-CDIO Engineering Education Mode

The Construction of the Overall Plan of Big Data Talent Training

The major of data science and big data technology, as a multi-disciplinary integration major serving the new economy and formats, not only face the future but also integrates the existing information discipline resources. This major has the characteristics of strong interdisciplinary, high knowledge requirements in the fields of mathematics and information. According to OBE's teaching concept, the society's demand for big data professionals and the orientation of major education is based on the results-oriented guiding principle. However, with the rapid development of big data technology, the demand for talents is also changing. To adapt to this change, the training objectives and contents of big data speciality should be adjusted at any time. When the needs of the current society are understood clearly, scientific and reasonable personnel training mechanism can be formulated, and personnel meeting the needs of the society can be trained.

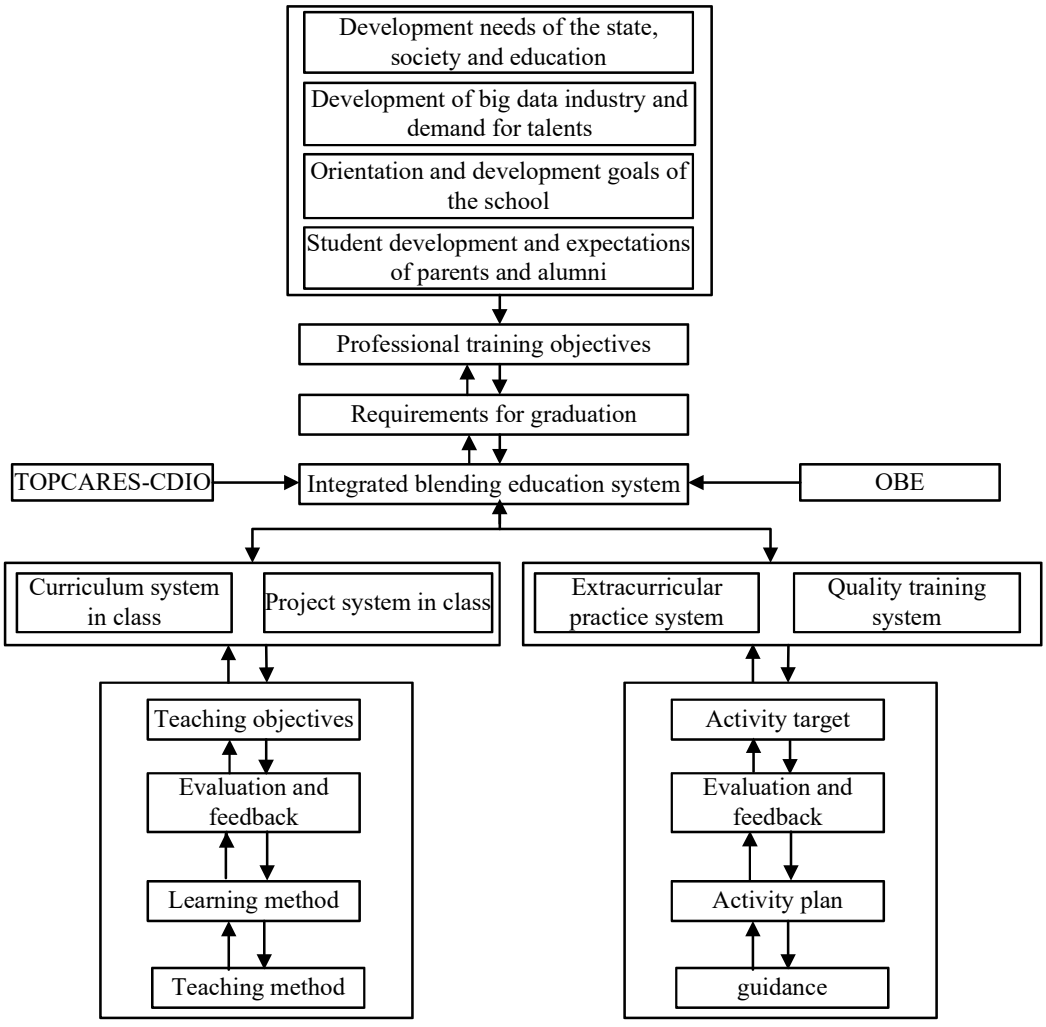

Figure 1. The Overall Design for Big Data Talent Training

Figure 1 shows the overall design scheme of big data talent training, which is student-centred. Based on meeting the needs of the society and combining with the characteristics of the school, the training objectives of the major are designed, and the abilities and levels that students should reach when they graduate are also defined. Through the integrated blending education, combined with the characteristics of the school's TOPCARES-CDIO and OBE teaching concepts, the overall program of big data talent training has been constructed.

In the blending education system, teaching in class is mainly based on theoretical courses and practical projects. Through the design of teaching objectives, evaluation and feedback mechanism, learning methods and teaching methods, the reverse ability objective matrix is constructed, and the teaching objectives are realized through reverse design and forward implementation. The training system includes extracurricular practice system and quality training system. Through the reverse design of activity goal, evaluation and feedback, activity plan and guidance, the activity goal is realized and the ability of students is cultivated.

Establishment of Talent Training Objectives

At present, the research and development of big data technology mainly embodies in four aspects: basic theory, key technology, the practice of application and data security. The connotation of this major determines the knowledge and ability that students need to learn and master, which is one of the bases for the establishment of talent training objectives.

Therefore, the orientation of this major is to cultivate the all-round development of morality, intelligence, physique, beauty and labour, have good professional ethics and humanistic quality, can design and maintain the big data platform architecture, data modelling and analysis, and solve industrial application problems, and have the lifelong learning ability in the information age.

At the same time, facing the big data-related fields such as health care, e-commerce, education, transportation, etc., students can undertake the tasks of big data platform architecture design, data collection, storage and management, data analysis and visualization, and can be engaged in big data analysis, processing, service, development and utilization in various industries in corresponding fields, to cultivate high-quality and applied senior professionals with social responsibility, innovation spirit, international vision and strong practical ability.

Establish Graduation Requirements

The training objectives of the major are used to describe and set the general requirements of the quality and specifications that can be achieved or met by the students of the major several years after graduation (LI, ZHENG, & ZHANG, 2018). The training objectives should have some characteristics such as forward-looking, stability and backtesting, and should be combined with the school's positioning, industry development and school discipline characteristics to develop a distinctive training program.

Graduation requirement is a specific description of the knowledge, ability and quality that students should master after graduating. It is one of the core links of the training scheme design. Graduation requirement plays an important supporting role in the achievement of training objectives and an important guiding role in the design of the curriculum system. Most of the sub-goals of the training objectives correspond to the graduation requirements. These graduation requirements must be achieved after the end of the undergraduate education stage,

and the achievement of some of the training sub-goals is also related to the later personal efforts of graduates. Based on CDIO's education and teaching concept, with knowledge, ability and quality training as the core (He, & Wang, 2018), the graduation requirements in engineering knowledge, problem analysis, design and development plan, research, team, communication, project management, lifelong learning, use of tools, engineering, sustainable development, professional specifications, etc. are determined.

Building an Integrated Blending Education System in Class

The indicator points required for graduation are mapped to multiple groups of three-level ability indicators in the TOPCARES-CDIO training mode. The training of the three-level ability index is completed by the courses, projects and activities in the talent training program. Each course in the course system has a supporting role for the target point required for graduation (the three-level ability of TOPCARES-CDIO). The mapping relationship between the training objectives and the three-level capabilities of TOPCARES-CDIO is shown in Figure 2.

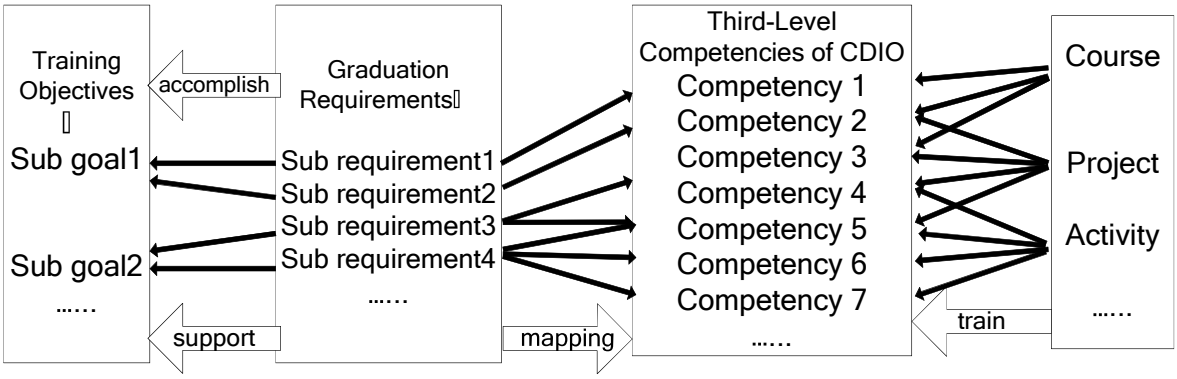

Figure 2. The Mapping of Training Objectives to TOPCARES-CDIO Three-Level Competencies

The curriculum system is not only an important support to achieve the training objectives, but also the core to improve the quality of big data talents. Under the TOPCARES-CDIO methodology, the University and enterprise jointly designed big data technology system based on five new technologies. Taking the technology of big data talents as the breakthrough point, this paper discusses the technical requirements of data analysis engineer, data algorithm engineer and data development engineer talents, and designs the technical system based on data acquisition, data processing and storage, data visualization, etc.

At the same time, through the post technology system, facing the health, education and other industries, the construction of the curriculum system and project system of big data are achieved by using the integration of industry and education. Based on the basic courses, professional basic courses, professional compulsory courses and professional elective courses as the basic modules, combined with practical projects and training projects, and strengthened the cooperation between schools and enterprises, the application-oriented talents in the field of big data are cultivated by the blending education mode.

Also, guided by students' output, schools and enterprises jointly build online and offline teaching resources. These resources involve integrated classroom teaching, practical projects, practical training projects and graduation projects. The teaching implementation process of

each link pre-class, in-class and after class, and run the blending education throughout the four-year learning process of the undergraduate course are designed, as is shown in Figure 3.

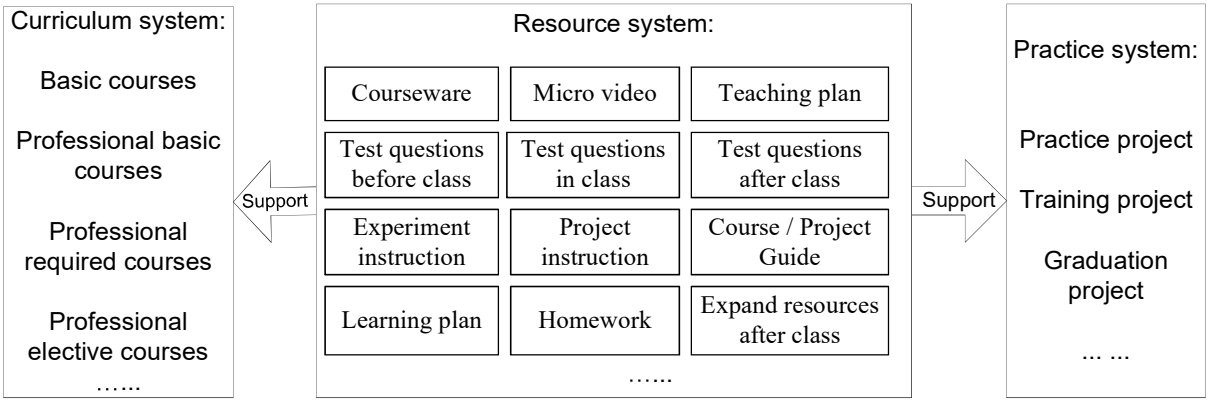

Figure 3. Blending Curriculum Resource System

Building a Blending Extracurricular Education System Under the Tutor System

Relying on Teachers' scientific research projects, students are provided with rich extracurricular learning resources. Under the guidance of tutors, the guidance and learning are carried out online and offline, and the extracurricular blending education practice system is constructed.

The system is based on interest groups and communities, with laboratories, engineering practice education centers, innovation and entrepreneurship centers, and internship bases inside and outside the school as places, with scientific research projects, innovation and entrepreneurship training projects, professional competitions, and internship projects as ways.

With the enterprise tutor and class tutor as the double teachers, assistant counsellor and assistant teacher as the double assistance, the quality training of students is organically combined with the ability to master knowledge, develop ability and solve engineering projects. A series of special lectures, short extracurricular courses, scientific research salons, special training and discipline competitions are held every year. Also, we will carry out targeted quality-oriented education projects, school league work, Party construction work and ideological education, focus on cultivating students' comprehensive quality ability, and build a blending education quality training system, which is shown in Figure 4.

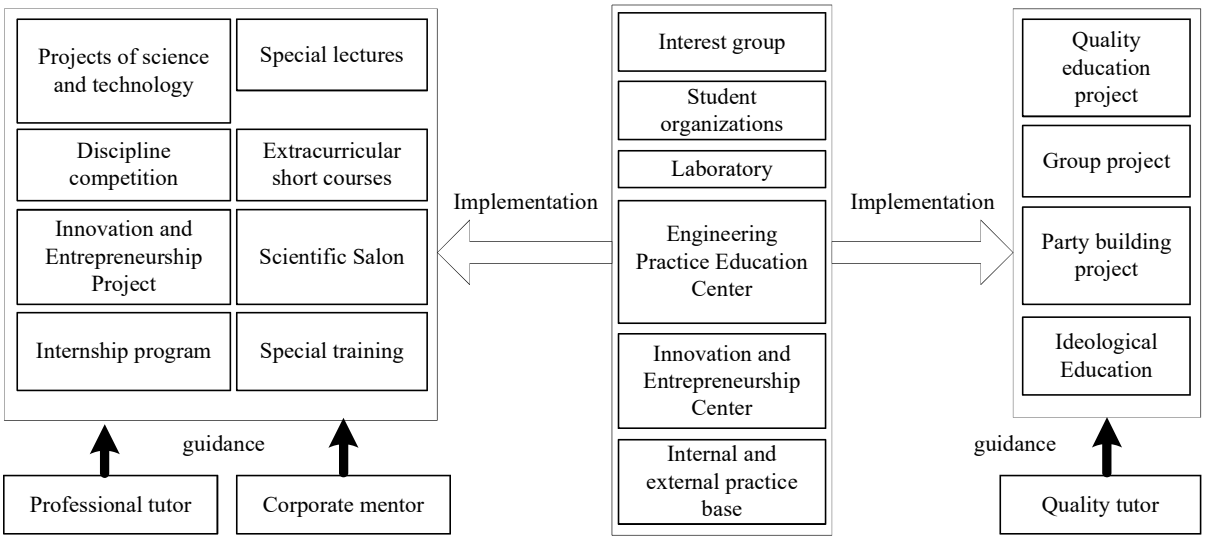

Figure 4. Extracurricular Blending Education System

THE DESIGN OF PRACTICE PROJECT IN BLENDING EDUCATION

The paper takes the project "data acquisition and preprocessing practice" as an example course to carry out research. The technology involved in this project is one of the necessary skills for the current popular data acquisition positions and data preprocessing positions. Through the method mentioned above, the graduation ability is mapped to the ability index of this course, and the training ability of this course is obtained as follows: learning attitude and habit, lifelong learning, professional knowledge and software realization processability. Based on the concept of OBE, the graduation requirements of the major are mapped to the three-level CDIO ability indicators that need to be cultivated. The curriculum system, project system and activity system of cultivating ability index are derived and determined in reverse. Through the way of reverse matrix, we can deduce each link of ability training in reverse, to further deduce project objectives, assessment methods, students' learning methods and teachers' teaching methods.

The course teaching design is jointly developed by the training program staff, the course leaders and the course team (Li, 2018). The general objectives of the course are defined according to the professional CDIO three-level competence indicators. Following decomposition, the specific course objectives are obtained and jointly demonstrated by the corporate mentors on whether or not they can be evaluated, thus determining the feedback and evaluation of the course, forming the evaluation method of the course. This step also needs to be reviewed by relevant personnel. It needs to define how students can achieve evaluation criteria based on evaluation plans, from which how teachers teach and which teaching resources are needed can be derived. At the same time, the rationality of the design needs to be reviewed again. The basic process of course design is shown in Figure 5.

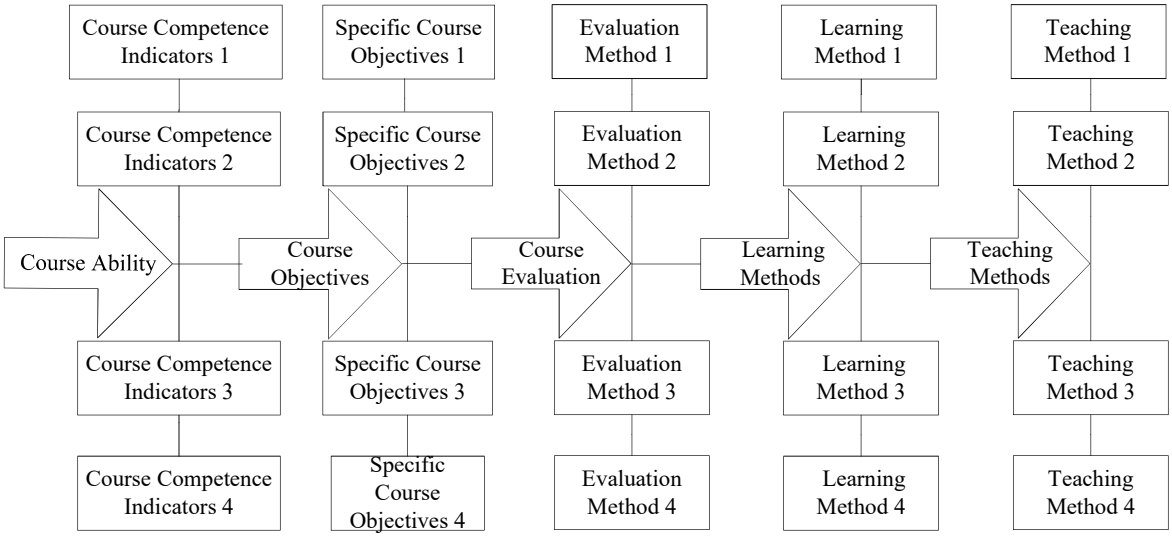

Figure 5. The Basic Process of Course Design

The project design scheme is completed six months before the class starts, and also the project review is organized and completed. In the course of curriculum implementation, it is necessary to continuously monitor and improve the implementation, and complete the mid-term and comprehensive review of project implementation to guide project improvement.

In the process of design and implementation of the project, research, evaluation and other links are combined with the cooperative enterprise, and enterprise experts are invited to participate. The project from content design to implementation process should meet the needs of the enterprise. The cases and related projects in class are based on cooperative enterprises, or come from the decomposition content of enterprise projects, or include the background of enterprises.

The teaching model of the project is mainly project-driven, case teaching, group discussion and other methods. At the same time, face-to-face teaching and online teaching support each other to guide students to make full use of online resources to achieve learning, consolidation and improvement.

Teaching Resources Construction of the Project

Starting from the needs of big data talent training and social needs, breaking through the traditional project construction ideas, based on the enterprise's advanced technology, popular framework and scientific research, combined with the professional construction talent training ideas and practical curriculum system, a three-dimensional teaching resource structure suitable for professional projects has been formed.

With the deepening of teaching and the investigation of students' cognitive level, the dimension and complexity of project resources gradually increase. The design idea of project resources is shown in Figure 6.

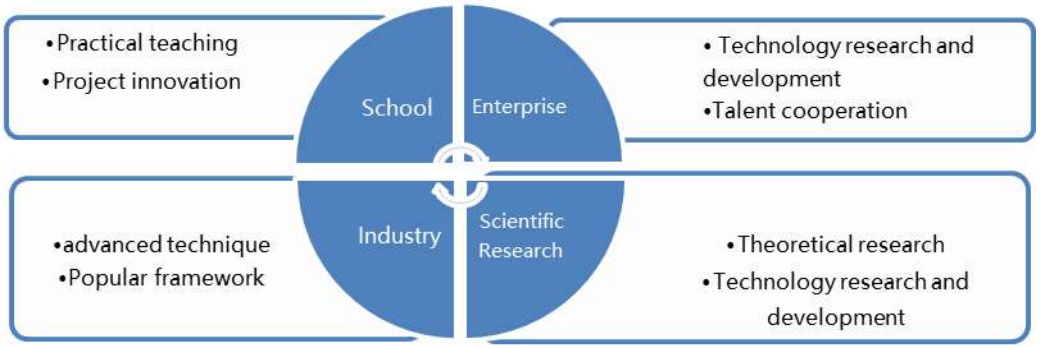

Figure 6. Design Ideas of Project Resources

Based on the design idea of professional integration, project resources involve the whole life cycle of data engineering, such as big data collection, data storage and processing, data analysis and visualization. For each stage of the project, it involves project standards, teaching calendar, courseware, micro-video, project guidance, teaching plans, cases, assessment, learning guidance and other basic resources.

Based on covering the above-mentioned resources, the resource construction of each stage presents the characteristics of hierarchy, focus and professional plate, which are embodied in the differentiation of resource focus.

Design of Teaching Implementation Plan for the Project

With the popularity of the internet and the application of intelligent terminals in education, the blending education model of MOOC+ SPOC+ Micro Class + flipped classroom has become feasible and realistic (Li, & Han, 2017). In this paper, the entire teaching process includes three stages: pre-class, in-class and after class. Learners are at the centre of the blending education and they don't limit to single course teaching method. Instead, they endeavour to exert their subjective initiative and take the initiative to acquire knowledge actively. What they need is a new learning model, so they can take full advantage of new technologies and methods.

Before class, students need to complete the tasks assigned by teachers in advance, complete the pre-class tests, and record the difficulties encountered in self-study, so that students can ask questions to teachers in class. In the class, combined with the actual needs of scientific research projects, teachers make full use of information technology, stimulate students to think actively, and guide students to analyze and process massive data in various forms through case teaching and other ways. Part of the teaching content can be set up as the flipping mode. Teachers can use various forms to interact with students, such as shooting curtain, answering questions, random questions, etc. At the end of the course, the achievement degree of the learning ability is evaluated.

After class, students complete their homework and are evaluated by the relevant test. Through the big data analysis function of the platform, teachers can know the learning state and ability achievement of students in real-time. The blending teaching process of this project is shown in Figure 7.

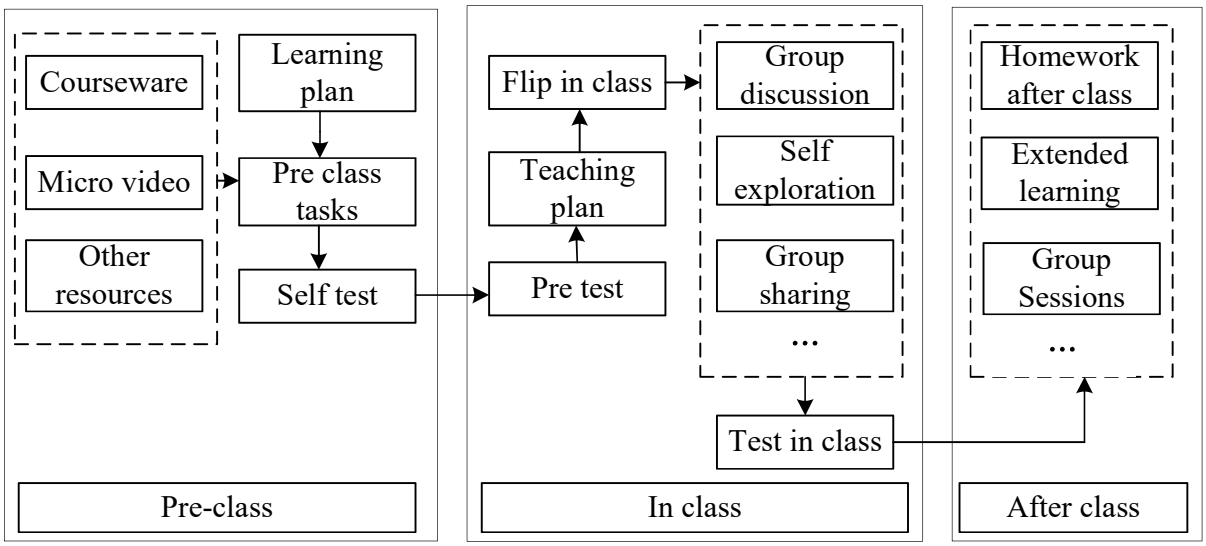

Figure 7. The Designed Blending Teaching Process

In the project design, the blending education mode is organized according to the three links of pre-class, in-class and after class, which conforms to the memory rule of human in brain science.

The preview before class is a process of memory collection. At this time, the primary knowledge model can be built. The discussion in the class is a process of memory processing. At this time, the brain sorts out the primary knowledge model and form a knowledge framework. The review after class is a process of memory solidification and knowledge application.

The formative assessment of the project includes interaction in class, tasks before class and activities after class. This kind of assessment method fully considers the different dimensions of the learning process and realizes the comprehensive training of students' knowledge, ability and quality. The final assessment is used to comprehensively investigate the learning effect of students on this project.

To ensure the effect of curriculum implementation, the systems of class tutor and enterprise tutor are introduced. Through the communication with the teacher and the tutor in time, establish the communication channels for students of different grades and levels, to facilitate the organization of students' after-school learning. The enterprise tutor brings the advanced and popular technology into the class, and helps the students master the technology framework synchronized with the enterprise in real-time through irregular online communication and school lectures.

Also, combined with this project, the competition of data acquisition and preprocessing is designed for the first time to promote the teaching implementation of a big data project. Students can relate their knowledge with the application environment of the actual production environment, and finally apply it to the practice.

16 excellent student works are included in the competition. The total amount of data obtained is 3 million, the amount of data cleaning is 2.5 million, and the number of visualization charts is more than 300. Through this competition, students' ability to use professional knowledge, learning ability and problem-solving ability can be effectively improved.

CONCLUSION

Data science is a new subject in the era of big data. It requires students to collect, store, clean, analyze and develop massive data from the perspective of industry. In this paper, the OBE education mode for engineering certification is introduced. Under the TOPCARES-CDIO methodology, combined with the blending education mode, the training objectives and graduation requirements of big data professionals are confirmed.

At the same time, the school and the enterprise have constructed the integrated blending education system, including the curriculum system and the project practice system of the integration of production and education in class, the integrated practice system and the quality education system of the extracurricular tutor system, as well as the implementation and adjustment of the evaluation and feedback mechanism are synchronized, to realize the closed-loop of talent training.

In the implementation and exploration of blending education, taking the project "data acquisition and preprocessing practice" as an example, this paper expounds the mapping process from training objectives to CDIO three-level ability indicators. Through the reverse matrix, the course objectives, assessment methods, teaching methods and learning methods are designed. Through the introduction of blending education platform, the centre of students, the teaching implementation of each link, such as pre-class, in-class and after class can be improved, to achieve the cultivation and improvement of students' professional ability, learning attitude and habits, lifelong learning ability. It is conducive to the improvement of students' software realization ability and the cultivation of big data professionals who can meet the current needs and future development.

After the practical exploration of this major, the OBE education mode and TOPCARES-CDIO methodology are combined to design the talent training mode. The practice of integrating blending education model proves that the model can achieve good results in higher education talent training of big data.

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