

Collaborative Education Model of Data Science and Big Data Technology at Local University Under the Concept of Engineering Education Certification

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Abstract—In order to meet the specific needs of local enterprises and institutions for the ability of professionals in data science and big data technology, under the guidance of the concept of engineering education certification, we establish professional training objectives on the basis of combing the positioning and talent training levels of local colleges and universities, combined with the characteristics of more professional knowledge and rapid renewal of data science and big data technology. Then through the curriculum group mechanism and the closed loop process of teaching, learning, supervision and evaluation, we construct a cooperative education model whose professional curriculum system being regularly updated and improved with complementary knowledge in the first and second classrooms, whose relationship between theory and practice. The four-year teaching effect shows that the cultivation of students has met the requirements of goal oriented and continuous improvement.

Keywords—collaborative education model, engineering education certification, local University, data science and big data technology

I. INTRODUCTION

Engineering education certification is a qualification evaluation of engineering majors in undergraduate higher education aimed at improving the quality of engineering education in colleges and universities in China and improving the international competitiveness of engineering talents in China[1]. Taking output as the core and training objectives, graduation requirements, curriculum objectives and curriculum teaching as the key elements is the "main line" of certification work. The establishment of output oriented evaluation and continuous improvement mechanism is the "bottom line" of certification work[2].

Local undergraduate colleges and universities shoulder the responsibility of serving the local economy. The professional construction of the university should be output-oriented, oriented to industrial enterprises, aim at the demand of the industry for talents, connect the goal with the demand, and highlight the local characteristics. Therefore, taking the undergraduate major of "data science and big data technology (hereinafter referred to as BigData)" approved by our university in 2018 as the practice object. Through school enterprise cooperation, guided by the needs of enterprise projects, through the education project jointly built by industry and university, through the closed-loop mechanism of

supervision, guidance, learning and evaluation, and through the construction of professional resources such as curriculum group, build a collaborative education mode of internal and external linkage, integration of teaching and practice, and the first classroom and the second classroom together, so as to carry out the construction of new majors in a more scientific and efficient way.

II. TRAINING OBJECTIVE OF BIGDATA SPECIALTY UNDER THE CONCEPT OF ENGINEERING EDUCATION CERTIFICATION

As a cross integrated specialty covering mathematics, computer, big data technology and other fields, the major of BigData is faced with the problems of huge knowledge system, many knowledge contents and fast updating when organizing the curriculum system. Therefore, in the construction of specialty, it is necessary to avoid unclear professional direction, inaccurate positioning and isolated and unconnected curriculum contents in the curriculum system, which results in a problem of "platter" teaching. Therefore, at the beginning of professional construction in 2018, we carried out professional construction by benchmarking engineering education certification standards under the guidance of the concept of engineering education certification. Firstly, when determining the professional training objectives through multi-channel research such as questionnaires and expert visits, we should be guided by the ability needs of talent training, avoid setting up isolated, inefficient and insignificant courses for talent training, and make effective use of the limited time of the university for four years. Anhui Polytechnic University is a provincial university located in Wuhu in Anhui Province. The university has the background characteristics of engineering and the export of talents mainly focuses on servicing for regional demands. Therefore, when positioning the professional training objectives, it has established the professional positioning highlighting the characteristics of "big data technology", in combination with the strong demand for talents in big data analysis from many e-commerce enterprises with geographical characteristics (such as Three Squirrels Co., Ltd., a pure Internet food brand headquartered in Wuhu has a great demand for big data analysts who can help realize the precise marketing of goods) in the enterprise questionnaire, the specialty has determined "big data analysis and application" as the professional training direction.

Since the specialty is set up in the computer college, combined with the technical implementation route of big data analysis, and under the condition of ensuring the basic knowledge of data science, the training objectives of the design specialty are to cultivate high-quality application-oriented talents with solid theoretical foundation and strong engineering practice ability based on computer science and technology and big data acquisition, storage, analysis and visualization technology, Specifically, it can serve the big data technology service industry, has data scientific analysis skills, has new ideas and methods to apply big data analysis to specific fields, and has strong adaptability to new technologies.

III. CURRICULUM SYSTEM OF BIGDATA SPECIALTY UNDER THE BENCHMARKING OF ENGINEERING EDUCATION CERTIFICATION

A. Curriculum System Design

The knowledge system of the curriculum content of engineering education specialty should deeply reflect the actual connotation of "graduation requirements", that is, the curriculum content construction should focus on "graduation requirements", accurately judge the knowledge content, practically connect the knowledge needs, and accurately grasp the development trend of knowledge. Students' comprehensive ability to solve complex problems and high-order thinking is cultivated with difficult, deep, frontier and contemporary course contents [3-5].

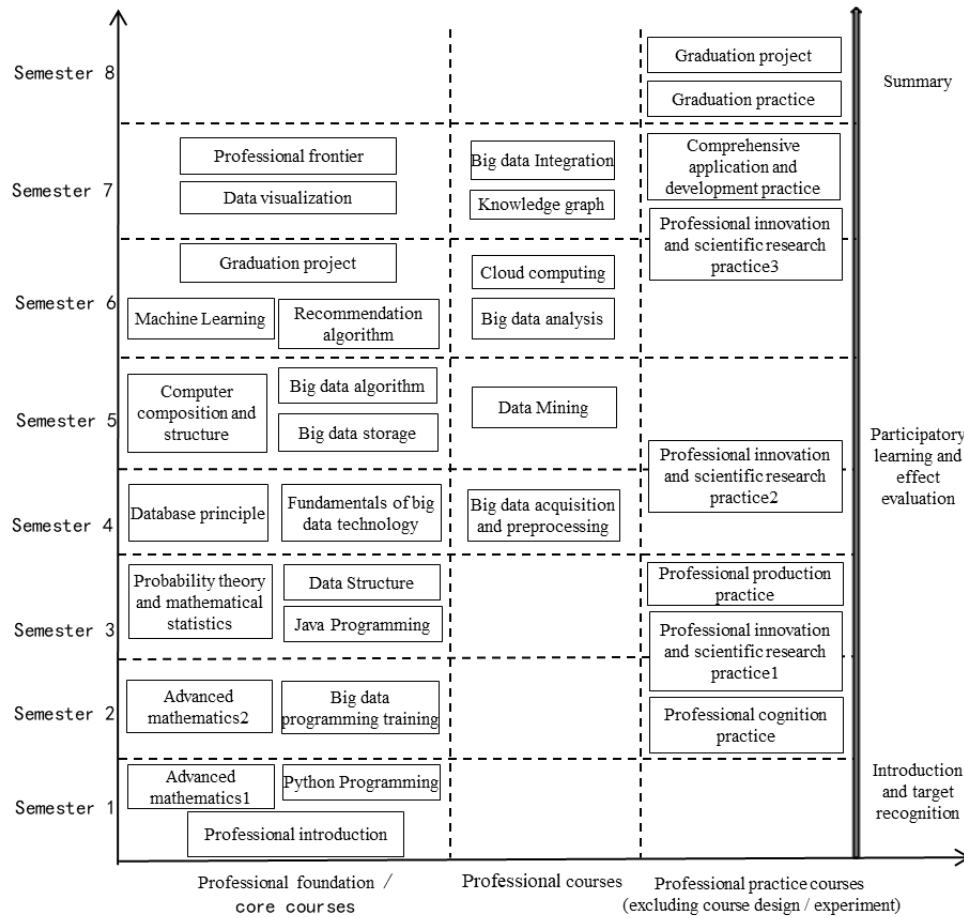


Fig. 1. Curriculum system diagram of BigData Specialty

Therefore, 1) a professional teaching Committee with the participation of enterprise experts has been established. According to the graduation requirements of big data analysis and application, the curriculum setting takes big data collection, preprocessing, storage, calculation analysis and visual application as the main line of the curriculum setting, and takes the ability of outputting talents as the starting point to establish the knowledge and ability correlation matrix of each specific course; 2) Fully tap the resources of industry university collaborative education project, make use of the training experience of engineering talents of cooperative enterprises, set up the characteristic course of "domain

knowledge + big data technology", and create big data application talents suitable for local needs; 3) Further strengthen cooperation with local enterprises, set up large comprehensive courses (4-10 weeks) in senior professional grades according to the requirements of professional fields, and carry out customized talent training in combination with specific applications and according to the talent classification and development system; 4) Build a teaching database, including classroom theoretical teaching materials (such as textbooks, handouts, etc.), experimental materials, learning instructions, summary of practical cases, etc., so as to make full use of teaching materials. At the same time, various

problems in the teaching process are summarized to make the teaching experience conducive to popularization; 5) In order to meet the personalized teaching needs of the new generation of students, adhere to the policy of "student-centered and achievement oriented" in the teaching process, determine the specific training objectives according to the social requirements for talents' ability in the teaching process, implement each focus to achieve the training objectives into each specific course, and implement the credit system, Introduce SPOC (small private online course), flipped classroom and other personalized teaching methods suitable for students' needs, and change "teaching oriented" to "learning oriented", so that students can learn more actively driven by interest, so as to achieve better learning results. The design of professional curriculum system is shown in Fig. 1.

In the process of curriculum construction, by clarifying the curriculum objectives, grasping the whole process of curriculum teaching, establishing curriculum groups, setting up curriculum responsible contacts, and continuously improving the curriculum level and quality by using the closed-loop improvement system of curriculum teaching feedback and sorting and updating the curriculum knowledge system. Specifically, courses such as big data programming and algorithm, big data acquisition and preprocessing, big data storage, big data analysis, big data visualization and application are set up. Under the organization of the person in charge of the course group and the person in charge of the

course (contact), regularly sort out and reconstruct the knowledge system of the course group and each course according to the opinions of the teaching supervisor, the teaching information officer, the discussion of the course group and the report of the course conclusion, so as to ensure the effective connection of the knowledge points of the course and avoid duplication of knowledge, At the same time, the outdated knowledge shall be updated in time (for example, the technology of big data platform is updated quickly, and new versions appear every year. The knowledge with great variability will be reflected in the curriculum knowledge system in time).

In addition, combined with the construction of online and offline teaching resources, and starting from the needs of society and students, provide students with knowledge content reflecting the current technology application, multi selectivity and personalization (for example, students planning to take the postgraduate entrance examination will pay more attention to the content of basic theory, while students with employment intention will pay more attention to the content of practical skills). That is, according to the concept of output oriented evaluation and continuous improvement of engineering education certification, complete the mechanism of continuously improving the curriculum system with the feedback of curriculum implementation process and results. The closed-loop improvement process of the curriculum system is shown in Fig. 2.

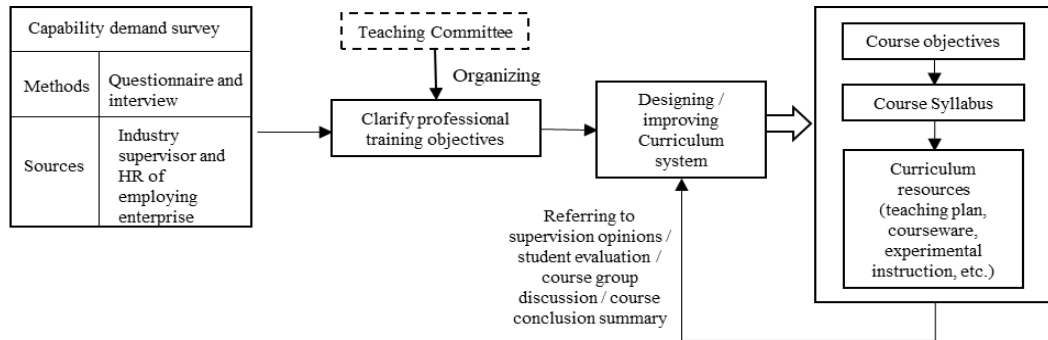


Fig. 2. Closed loop improvement process of curriculum system

During the course construction, through the unified planning of the course group, case design and the construction of course teaching resources, for the cohesive knowledge points in the course group, that is, organize and sort out the knowledge contents that should be explained before and after the course, especially pay attention to their difficulties, avoid disconnection or unnecessary repetition, and maximize the teaching efficiency of the course. For the update of knowledge and technology, a regular record and summary system is formed, and the updated and changed contents are added and adjusted in time in the knowledge system of subsequent courses[6]. The updating statistics of course knowledge points are shown in Table I.

TABLE I. STATISTICAL TEMPLATE OF COURSE KNOWLEDGE POINTS UPDATING CONTENTS

Course Names	Knowledge points in Chapters	Open sem.	Using technology of knowledge points	Updating records	Course contact
Professional introduction 2.1.1 data acquisition 2.1.2 collection tool (Python Requests Library)	1	1) Cases of smartphone sales in E-commerce Technology: Hadoop2.7	Nothing	Teacher Yang
Big data acquisition and preprocessing 3.3.1 Detailed explanation of requests Library 3.3.2 Examples.....	4	1) Cases of smartphone sales in E-commerce	Hadoop3.X 2021.09	Teacher Feng

B. Practical teaching design

BigData major of engineering category has high requirements for practical application. So the practical teaching plan is design as a practical teaching system based on experimental operation, taking design as the main line, relying on practice and combining with extracurricular scientific and technological activities, highlighting applicability and practicality, and paying attention to cultivating students' ability to solve complex engineering problems[7].

Through continuous teaching iteration, we implement practical teaching by combining the first classroom and the second classroom.

Nearly 30% of the first classroom practical teaching contents of the training plan include in class experiments (practical training for the knowledge points of the curriculum chapters), curriculum design supporting the curriculum (more comprehensive training for the overall knowledge of the curriculum, especially focusing on the training of students' summary and expression ability), professional awareness practice (completed in the second semester, select enterprises in the industry according to the graduation objectives, study by visiting and lectures, and focus on helping students understand the ability needs of the market for professionals), professional production practice (completed in the 5th semester, focusing on small and medium-sized cases of school enterprise cooperative enterprises. Through case reproduction, students can understand their abilities at the current stage of learning and the gap from actual needs), and comprehensive professional practice (completed in the 7th semester, focusing on relatively complete enterprise cases and enterprise technical training, so that students can test their learning before graduation and try to make up for their lack of ability).

Relying on the association of big data and artificial intelligence, the open innovation laboratory of big data and artificial intelligence and other discipline organizations, and according to the requirements of full coverage in engineering education certification, the second classroom has set up summer scientific and technological practice and innovation activities participated by all the staff to improve the students' ability to apply new knowledge and technology. In order to improve the interest and challenge of practical activities, actively cooperate with enterprises to carry out discipline competition activities sponsored by enterprises to replace conventional summer activities. Form a discipline competition mechanism in which all professional students participate in the school competition and select excellent students in the provincial National Competition (according to preliminary statistics, 75% of the first 2018 professional students have obtained provincial competition certificates); Due to the in-depth application of big data analysis technology in various enterprises in recent years, many enterprises need more big data talents to participate in the data analysis tasks of enterprises. Therefore, we introduce the school enterprise cooperation mode, set up enterprise projects and undergraduate scientific research projects, and encourage spare students to enter the discipline research laboratory and participate in the scientific research projects of enterprises and teachers. On the one hand, it broadens students' knowledge horizons and cultivates students' scientific thinking methods

and innovative consciousness. On the other hand, it also expands employment channels for many excellent students. Finally, through the formed leading mechanism of "discipline competition" and "subject driven", students' competition and scientific research achievements are timely injected into the teaching and experimental teaching links of the first classroom, so as to realize the closed-loop curriculum construction system of feeding the teaching content of the first classroom with the second classroom, and finally form a collaborative education mode of combining in class and out of class, and close linkage between the first classroom and the second classroom.

IV. TEACHING ASSISTANCE MECHANISM

According to the concept of engineering certification, a special teaching assistance mechanism is set up in the constructed closed-loop teaching process to provide teaching assistance for teachers and students.

In terms of teachers' dimension, teachers whose teaching effect is not ideal in the teaching feedback are collected for teaching information. Through the discussion of the course group, the problems are sorted out from the aspects of whether the teaching purpose of the course is clear, whether the teaching resources of the course meet the needs of knowledge points, and whether the teaching methods and management means meet the cognitive needs of students, so as to help these teachers complete the continuous improvement of teaching work.

TABLE II. UNDERGRADUATE TUTOR WORKING PLAN

Sem.	Working Plan	Frequency
1 st	Focus on professional cognition, and help students clarify the professional knowledge system and what kind of work they can do after graduation; Establish the learning objectives of the University; Whether the learning method is correct, whether the learning problems can be solved, and clear the channels and methods to obtain learning help.	Once every 2-3 weeks
2 nd	Deeply understand the professional curriculum system and sort out the links between professional courses; Clarify the learning difficulty of basic courses (such as advanced mathematics and linear algebra), and require students to spend more time; Recognize the importance of professional practice.	Once a month
3 rd	Clarify the learning difficulty of professional courses (such as data structure) and require students to spend more time; Remind students who plan to take the postgraduate entrance examination to improve their learning depth.	At least 3 times at the beginning, middle and end of the semester
4 th	Clarify the learning difficulty of professional courses (such as database and big data technology), and require students to spend more time; Remind students planning employment to strengthen practice.	At least 3 times at the beginning, middle and end of the semester
5 th ~ 6 th	Clarify the learning difficulty of professional courses (such as computer composition, computer network), and require students to spend more time; Remind students planning employment to strengthen practice.	At least 3 times at the beginning, middle and end of the semester
7 th ~ 8 th	Help students who take the postgraduate entrance examination and get employed plan their own study plans; Clarify the importance of professional practice; Accept various consultations from students.	Anytime

In terms of students, an undergraduate tutorial system is established, with each teacher corresponding to about 20 students (the tutor's working plan is shown in Table II). First, students with learning difficulties are encouraged to actively ask the help from undergraduate tutors; At the same time, undergraduate tutors will regularly carry out thematic activities such as learning discussions, in which students' learning problems will be found from the aspects of whether the teaching attitude is correct and the learning methods are appropriate. Once students with learning problems are found, the tutors will conduct individual conversation and counseling, and work hard from the subtle links of teaching management to try not to leave these students behind. In addition, in order to enhance students' interest in learning, personalized learning methods are formulated for students with learning difficulties, including the establishment of learning competition groups, so that extroverted students can improve their learning quality through mutual help; building an online learning community (the modules of the learning community include: professional basic course resource area, professional course resource area, postgraduate entrance examination special area, question and answer area), and trying to upload the knowledge content found through discussion in the community, so that introverted students can fill the gaps in time through online methods. At the same time, students are encouraged to share learning resources and actively communicate and exchange in the process of learning, especially the interaction between junior and senior students. It is hoped that senior students introduce more about the gains and losses of professional learning, and the admiration and praise of junior students to senior students can stimulate the learning enthusiasm of senior students. In short, the forms of assistance to students can vary from person to person. The goal is to make each student have a sense of gain and identity in professional learning, and can imperceptibly improve nonprofessional core qualities such as communication and teamwork.

To sum up, under the background of local colleges and universities and under the guidance of the concept of engineering certification, the BigData major of our university focuses on serving local needs by taking use of big data analysis and applied talent training objective. Through building a closed-loop, iterative, updated and perfect collaborative education system by taking close contact with internal and external resources, covering the first and second classes and combining theory and practice, the teaching task for the first professional students is completed, and the teaching effect is good. In June 2022, it was successfully

approved as a first-class professional construction site in Anhui Province.

V. CONCLUSION

The construction of curriculum system is a process that needs continuous improvement. In the next step, we will combine the feedback of graduates' ability achievement and the survey of enterprises' satisfaction with graduates, absorb the opinions of talent training from a richer perspective, and further combine the construction of hybrid (online and offline, theory and practice) curriculum resources, Continue to build a professional curriculum system that more meets the needs of graduation ability, so as to cultivate big data analysis and application-oriented talents that meet the output needs.

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