Teaching Practice of Big Data Technology Based on Integration of Science and Education

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Abstract. Big Data Technology aims to help students master the basic mechanisms and development methods of big data distributed storage and distributed computing. The course enables students to use common tools in Hadoop and its ecosystem to realize the access, processing, calculation and analysis of big data. Through the course, students' logical thinking and systematic thinking methods and habits of engineers would be cultivated, and the ability to analyze and solve complex engineering problems could be possessed. Therefore, taking Big Data Technology of the School of Software Engineering of Chengdu University of Information Technology as an example, two aspects of teaching resource construction supported by scientific research projects and reform of project-driven teaching methods were introduced, and the specific practice of the integration of science and education was realized. The practice provides a reference for promoting the application of the integration of science and education in higher education.

Keywords: integration of science and education, big data technology, project-driven, teaching resources

1 Introduction

Teaching and scientific research are the two most basic functions of colleges and universities. They are interdependent, promote each other, complement each other and develop together. Handling the relationship between them is of great significance for the development of higher education. From the early separation of science and education to the current integration of science and education, people have found that integrating research into teaching is crucial for higher education [1]. The essence of the integration of science and education is to combine them, and enrich teaching content through the scientific research results of teachers. Foreign research shows that consciously embedding research and teaching into students' learning [2], and letting students actively participate in inquiry learning of research is considered more beneficial than learning mode of the teacher-led, content-focused teaching for students' one [3].

The relationship between teaching and scientific research in colleges and universities in China has been from simple teaching to equal emphasis on teaching and scien-

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tific research, and then from equal emphasis on teaching and scientific research to the combination of teaching with scientific research, and then to the integration of teaching and scientific research [4]. At present, the concept of the integration of science and education has been generally accepted in China. The concept, connotation, dynamic mechanism, implementation path, and talent training model of the integration of science and education have been discussed. Innovative practices of the integration of science and education have been carried out in majors such as intelligent manufacturing [5], network security [6], information [7] and related courses. These practices involved discipline expansion, curriculum construction, teaching organization, teacher construction and form innovation [8] and other contents.

The data science and big data technology major is established to meet the requirements of the big data era and meet the increasingly strong demand for big data talents in society. This major is supported by computer disciplines, statistical disciplines, etc., and involves knowledge in disciplinary fields such as artificial intelligence, data visualization, machine learning, and data analysis. This major aims to cultivate compound talents with deep data analysis capabilities, cross-domain knowledge and innovation capabilities, as well as high-quality applied talents with big data thinking and mastering big data technology. The data science and big data technology major is a typical new technology field. This major is characterized by obvious technology-driven and field application-driven, so it is very conducive to implementing the teaching mode of the integration of science and education. Big Data Technology is a basic course for the major of data science and big data technology. Through this course, students systematically master the basic concepts, distributed storage, distributed processing and basic knowledge of big data analysis. This course plays an important role in the curriculum system. Therefore, taking the Big Data Technology as an example, the course teaching reform of big data major based on the integration of science and education was explored.

2 Construction of teaching resources supported by scientific research projects

The course resources include diversified contents such as textbooks, cases, courseware, etc. It provides rich materials for teaching and is the key to teaching effectively. Therefore, in order to improve teaching quality, the resource library of the Big Data Technology was established by the course team in various ways.

(1) Syllabus, textbooks and lesson plans

According to the principle of industry-oriented and results-oriented, the teaching syllabus was updated regularly with the participation of industry experts and revised every two years. The course content was synchronized with technological development and actual needs. The course textbook selects 'Principles and Applications of Big Data Technology (3rd)' compiled by Lin Ziyu of Xiamen University. This textbook belongs to the 'Series of Textbooks for Cultivating Big Data Innovative Talents' and comprehensively and systematically introduces the basic concepts, storage and processing technologies, analysis methods and application practices of big data technology. It was

used by many colleges and universities in China. In particular, this textbook was equipped with online resources such as MOOC, experimental instruction book, computer experiment questions and answers, after-class exercises and answers. According to the teaching syllabus and the textbook, the course lesson plan was written by the course group. The lesson plan arranges and designs the teaching objectives, teaching content, key and difficult points, and specific teaching process of each lecture. At the same time, the teaching PPT was made and the experimental instruction book was revised.

(2) Project case library

Referring to existing typical cases, according to the vertical and horizontal project resources undertaken by the course team teachers, combined with the the professional talent training goals of industry, the project case library was constructed through careful work. At present, the project case library includes 28 cases, including 13 basic cases, 13 advanced cases, and 2 comprehensive cases (from enterprise practice). The case library covers contents such as big data acquisition, access, processing, analysis, visualization, and industry applications, meeting the needs of students at different levels. As shown in Fig. 1.

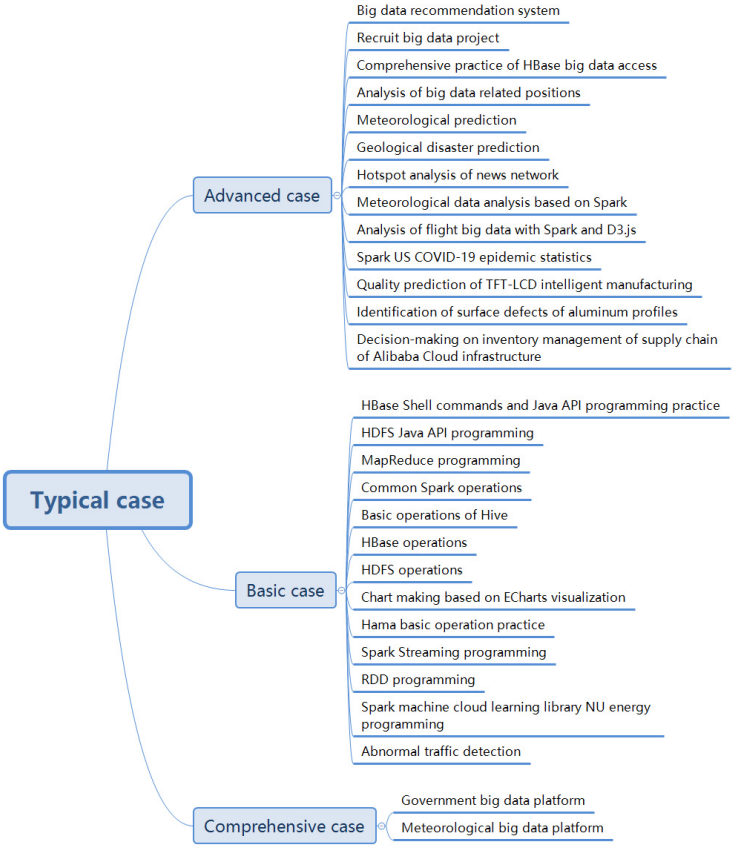

Fig. 1. Project case library [Self-drawn]

(3) Virtual simulation experiment teaching projects

'Big Data Open Online Practice Course' on the Touge practice teaching platform were adopted. The platform provided projects by the teaching team of National University of Defense Technology. These projects include data collection (crawler), machine learning and core algorithms, big data analysis and mining (Spark), data visualization display, face recognition system, tourism website big data analysis system project, enterprise job demand decision-making project, and shared bicycle big data analysis system project. These were used as extracurricular virtual simulation experiment projects to encourage students to complete a series of experiments, especially comprehensive project experiments. Rich experimental projects help students master core knowledge, exercise logical thinking, and improve the ability to develop big data projects.

(4) Digital video resources

The course needs to cultivate students' autonomous learning ability. Teaching breaks the limitation of classroom hours. Following the idea of integrating inside and outside the classroom and mixing online and offline, the teaching team has established a video resource library. At the same time, excellent electronic resources such as 'Big Data Algorithms' from Harbin Institute of Technology, 'Basics and Applications of Big Data' from Beijing Institute of Technology, 'ECharts Data Visualization Project' from the public class of Heima Programmer, 'Industrial Artificial Intelligence Practical Course' from Yang Xiaochun, and 'Meteorological and Marine Data Analysis' from the Whale Community were also recommended to students. These video resources are for students to selectively study according to their own situations.

3 Reform of project-driven teaching methods

In order to better practice the integration of science and education, the project-driven teaching method was adopted in the teaching of the Big Data Technology. The project-driven teaching method takes the cultivation of engineering practical ability as the main line and takes students as the center. Students' subjective initiative would be fully mobilized.

(1) Project-driven teaching

The project-driven teaching method requires the introduction of the project in the first class. So that students have an overall understanding of the project. Students were required to look up relevant information after class to deepen their understanding of the project. Then the 'government affairs big data' project was decomposed into several modules. Relevant modules were introduced when explaining theoretical knowledge. Under the guidance of the teacher, students actively think. Finally, students were required to complete the design and development of the module in the practice link.

Taking the explanation of the content of 'Hadoop design concept and basic architecture' as an example, how teachers carry out teaching based on project-driven would be expounded.

1) Problem introduction: Government affairs big data includes natural information (geography, resources, meteorology, environment, water conservancy, etc.), urban

construction (transportation facilities, tourist attractions, residential construction, etc.), urban management statistics and supervision (industry and commerce, taxation, population, institutions, enterprises, commodities, etc.), services and people's livelihood consumption (water, electricity, gas, communications, medical care, travel, etc.) and other data. These data have typical characteristics of 4V . These data sets need to be stored and managed, and provide basic support for data sharing and exchange. Students were given the question of whether it was feasible to use traditional databases for storage? If not, students should analyze the reasons. Through problem introduction, deepen students' understanding of project cases. At the same time, students could learn the content of this lecture with questions.

2) Classroom discussion: Combined with the knowledge of the Hadoop ecosystem, students were required to discuss in groups about the tools that could be selected for the government affairs big data platform project. The teacher could select two groups of students to answer, give a simple evaluation, and give the final plan.

3) Homework after class: According to the plan provided by the teacher, students were required to build the development environment of the government affairs big data platform project.

(2) Project-driven technological innovation

According to the characteristics of students' learning situation, students with ability and interest would be selected to participate in scientific research projects. At the same time, teaching students in accordance with their aptitude and the cultivation of students' 'five abilities' would be payed attention to. With scientific and technological innovation as the link, scientific research projects and course teaching were connected. Top-notch students were encouraged to participate in scientific research practice, and the dominant position of students in scientific research activities was improved. In this way, students' scientific research interests would be stimulated and students' scientific research confidence would be effectively cultivated. Students could discover the need for professional knowledge through scientific research practice. Thus, course teaching was promoted.

4 Conclusion

Under the rapid development of the big data industry, the integration of science and education has become an inevitable requirement for the cultivation of big data talents. According to the course content and characteristics of Big Data Technology, the concept of the integration of science and education was fully integrated into teaching. Supported by scientific research projects undertaken by the teaching team, curriculum resources such as project case library, virtual simulation experiment teaching project, digital video, and lesson plan have been constructed. The reform of project-driven teaching methods has been realized. Teaching quality would been effectively improved. Students' engineering practice ability and innovation ability could been improved.

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References

1. Hattie. J., Marsh. H. W. The Relationship Between Research and Teaching: A Meta-analysis, Review of Educational Research, vol. 66, pp. 507-542, 1996.
2. Brew. A., Mantai. L. Academics' Perceptions of the Challenges and Barriers to Implementing Research-based Experiences for Undergraduates, Teaching in Higher Education, vol. 22, pp. 551-568, 2017.
3. Brew. A. Teaching and Research: New Relationships and Their Implications for Inquiry-based Teaching and Learning in Higher Education, Higher Education Research and Development, vol. 22, pp. 3-18,2003.
4. X. Z. Lu. Better Combination of Teaching and Research in Universities from the Perspective of Science and Education Integration, China Higher Education Research, pp. 32-38, 2023.
5. F. Q. Zhang, J. Z. Hui, Q. T. Liu, et al. Exploration on Undergraduate Talent Training Mode of Intelligent Manufacturing Based on the Integration of Science and Education, The Guide of Science & Education, pp. 67-70, 2021.
6. L. Y. Zhang, J. Q. Li, W. Lu, et al. The Innovation and Practice of the Talent Training Mode of Cyber Security with the Features of Science -Education Integration, Journal of Information Security Research, vol. 9, pp. 921-927, 2023.
7. S. H. Zhao, G. L. Chen, C. Y. Yu, et al. Exploration on the Training of Information Talents in the Integration of Science and Education for Application-oriented Colleges and Universities, Journal of Chuzhou University, vol. 24, pp. 103-107, 2022.
8. J. Yu, F. Chen, Y. X. Fang. A Preliminary Exploration of the New System of Research-Education Integration for the Construction of a Scientific and Technological Powerhouse, Journal of Science, Technology and Education Studies, vol. 2, pp. 55-78, 2022.