Application Research of PBL Teaching Mode in Core Course Construction for Big Data Major

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Abstract: With the rapid development of big data technology, there is a higher demand for cultivating talents in big data. The traditional teaching mode cannot meet the comprehensive ability requirements of society for big data talent at present. This paper aims to explore the application of problem-based learning (PBL) teaching model in the construction of core courses of big data major. Through literature review, teaching practice and effect evaluation, this paper analyzes the impact of PBL teaching model on improving students' critical thinking, teamwork and complex problem-solving abilities in big data majors. The research results show that the PBL teaching model can significantly improve student's motivation and practical application capabilities, providing effective teaching strategies for the construction of core courses of big data majors.

Keywords: PBL Teaching Model; Big Data Major; Core Courses; Teaching Strategies; Ability Cultivation

1. Introduction

1.1 The Importance of Big Data Professional Education

With the rapid development of information technology, big data has become a key factor driving social progress and business innovation [1]. Big Data professional education aims to cultivate professionals who can handle and analyze large-scale datasets, requiring them to possess interdisciplinary knowledge structures and skills including computer science, statistics, applied mathematics, etc. Therefore, the importance of Big Data professional education is increasingly evident, with its educational quality directly affecting national competitiveness and social development [2]. The advent of the era of big data makes data analysis and processing technologies indispensable tools for all industries [3]. To meet the demand for Big Data professionals in society, universities have established related majors and are committed to building an integrated core curriculum system [4]. However, traditional teaching models often focus on knowledge transmission while neglecting students' practical ability and innovative capacity cultivation [5]. Hence, exploring a teaching model that can stimulate student's active learning interest and enhance their comprehensive abilities becomes particularly important [6]. Problem-based learning (PBL) mode, which features problem-orientedness, student-centeredness and practicability, has become an important direction for reforming core courses in Big Data professional education. The traditional teacher-centered teaching model cannot meet the needs of big data professional education. Students need to learn and apply knowledge in practice. The problem-based learning (PBL) teaching mode, with its student-centered and problem-driven characteristics, can stimulate students' interest in learning, cultivate their self-learning ability and innovative thinking. Therefore, introducing PBL teaching mode is of great significance for big data professional education [7]. The specific importance is shown in Figure 1 below:

1.2 Introduction Background of PBL Teaching Model

The traditional teacher-centered teaching model cannot meet the needs of big data professional education [8]. Students need to learn and apply knowledge in practice [9]. The problem-based learning (PBL) teaching mode, with its student-centered and problem-driven characteristics, can stimulate students' interest in learning, cultivate their self-learning ability and innovative thinking [10]. Therefore, introducing PBL teaching mode is of great

significance for big data professional education [11].

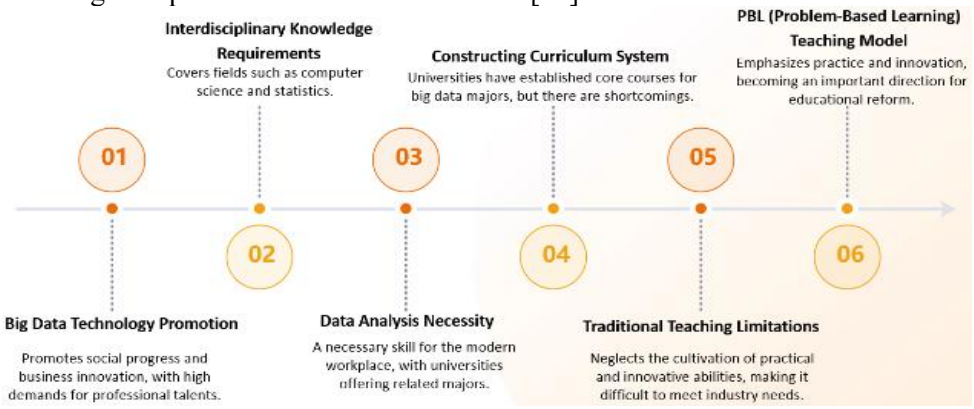

Figure 1. The Importance of Big Data Professional Education

1.3 Research Objectives and Significance

This study aims to explore the application effect of PBL teaching model in core courses for big data majors, analyze its impact on students' ability cultivation and put forward corresponding teaching reform suggestions [12]. This has important theoretical and practical significance for improving the quality of education in big data major and cultivating high-quality talents that meet industry needs [13].

2. Literature Review

Researchers in China and abroad have achieved rich results on research of PBL teaching mode [14]. Studies show that PBL teaching model can significantly improve students' learning motivation, critical thinking and problem-solving ability [15]. At the same time, this model has also achieved significant achievements in many fields such as medicine, engineering and education. However, there are relatively fewer studies on the application of PBL teaching mode to core courses for big data majors. Therefore, based on the previous research findings and combined with the characteristics of big data major, this paper conducted a deep study on the application of PBL teaching mode to the construction of core courses for big data majors.

2.1 Theoretical Basis of PBL Teaching Model

The Problem-Based Learning (PBL) teaching model originated in the 1960s at McMaster University's medical school in Canada. Its core concept is to promote learning through solving practical problems. PBL emphasizes student active participation and collaboration, requiring students to work together as a team under the guidance of teachers to solve open-ended questions, thereby gaining knowledge and skills.

2.2 Characteristics of Core Courses in Big Data Major

The core courses of big data majors usually include data mining, machine learning and big data analysis. These courses require students to have strong theoretical foundations and practical abilities. The course content involves a large amount of data processing and analysis techniques that need students to be able to apply interdisciplinary knowledge to solve real problems. The characteristics of the core courses in the major of big data are shown in the following Figure 2.

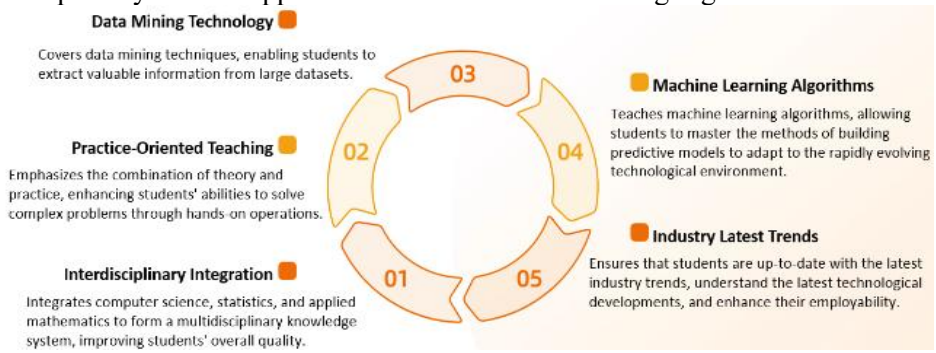

Figure 2. Characteristics of Core Courses for Big Data Major

2.3 Application Status of PBL in Big Data Education at Home and Abroad

In recent years, the PBL teaching model has been widely applied in big data education both domestically and internationally. Studies have shown that PBL can improve students' learning motivation and participation, promote their critical thinking and problem-solving abilities. However, implementing PBL also faces some challenges such as difficulty in course design and insufficient teacher training. The big data core courses of a university are shown in Figure 3 below:

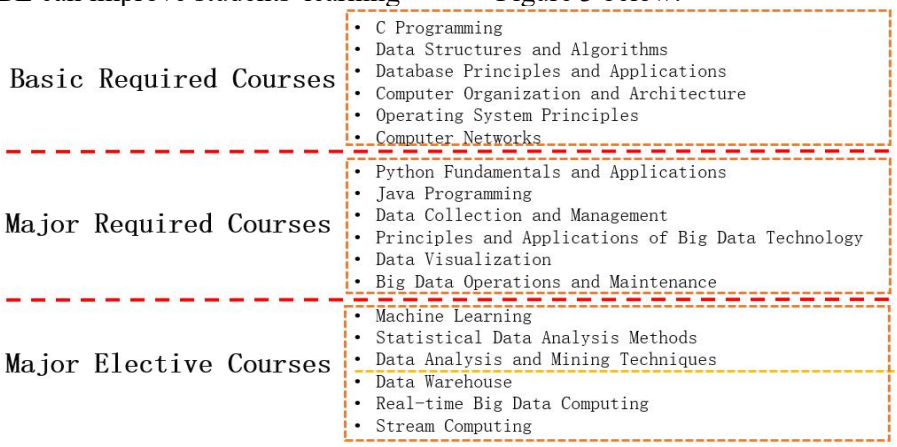

Figure 3. Big Data Core Course of a University

3. Research Methods

This article uses literature research, case analysis, questionnaire survey and interviews to comprehensively analyze the application of PBL teaching model in the construction of core courses for big data majors. Firstly, through a review of relevant literature, this paper summarizes the basic theories, characteristics and advantages of PBL teaching mode; Secondly, based on the content and objectives of the core courses taught in big data major, an instructional reform scheme based on PBL was designed; Then, some classes from a certain university's big data major were selected as experimental subjects, and questionnaires and interviews were used to evaluate the effectiveness of the experiment.

3.1 Research Design

This study adopted a mixed method research design, combining quantitative and qualitative methods. Data were collected through questionnaires and interviews to evaluate the effectiveness of PBL teaching model in core courses for big data majors.

3.2 Sample Selection and Data Collection

The research sample included undergraduate students and teachers from a certain university's big data major. Through distributing questionnaires and conducting semi-structured interviews, we collected student acceptance of the PBL teaching model, learning effects, and teacher experiences with implementing this model.

3.3 Data Analysis Methods

The statistical analysis of questionnaire data was conducted using Anaconda software, including descriptive statistics, correlation analysis and regression analysis. The interview data were analyzed by content analysis method to extract key themes and patterns.

4. Empirical Research

4.1 Course Design for Implementing PBL Teaching Model

This study selected a core course in big data major, machine learning, as an object for implementing the PBL teaching model. The course design followed these steps:

Course goal setting: Clearly define the learning objectives of the course, including knowledge acquisition, skill training and ability development.

Problem selection: Select problems that are closely related to actual applications according to course objectives as the core of learning.

Learning resource allocation: Provide students with necessary learning resources, including textbooks, online courses and database access rights.

Team building: divide students into several teams, each team is responsible for solving a

problem.
Time arrangement: Allocate enough time for each question to ensure that students can delve deeply and discuss.

4.2 Implementation Process of PBL Teaching Model

The implementation process of the PBL teaching model includes several stages.

4.2.1 Pre-task phase

Project selection: Course objectives setting: Teachers need to set course objectives according to students' interests and subject curriculum standards, ensuring that the objectives meet educational requirements while also stimulating student interest.
Topic selection: Choose a driving question or task that can inspire students to conduct autonomous exploration based on their existing knowledge. This question should be related to the field of machine learning and guide students in deep exploration.
Task planning: Project plan: Ask students driving questions to clarify project tasks, find solutions and draw conclusions. This plan should include a timeline for the project, resource requirements, expected outcomes, etc.
Clear organizational form: In PBL mode, students achieve collaborative inquiry through group activities. Each member of the group has their own role and contributes to the team's efforts. It is recommended that the number of members in a group be controlled between 3-6 people.
Task planning: Students need to develop detailed task plans based on driving questions, including task decomposition, role allocation and time planning, ensuring that the project can be carried out in an orderly manner.

4.2.2 Phases in tasks

Collaborative inquiry: Driving question exploration: Under the guidance of teachers, students choose or determine research topics based on their own interests around driving questions.
Knowledge acquisition: Students actively acquire knowledge through observation, recording and thinking. They use machine learning tools and methods to collect and analyze data.
Problem solving: Analyze and solve problems through group collaboration, emphasizing teamwork combined with personal experience to complete various tasks.
Work creation: Software outcome form: The forms of works produced during the project process are diverse, including but not limited to machine learning models, software applications, algorithm implementations, etc. These works should be able to demonstrate students' understanding and application of machine learning concepts.

4.2.3 Post-task phase

Results exchange: Design and production are completed: guide students to use various tools and information technology methods for design and operation, transform project experience and harvests into physical or works such as machine learning models, software applications, etc.
Result display and exchange: Students present their project results in various ways through groups, while teachers organize students to report on and explain the creative ideas, production process and inner journey of works.
Evaluation and reflection: Evaluation type: Machine learning course evaluation focuses not only on final results but also emphasizes implementation processes. Evaluation combines formative and summative evaluations, with a focus primarily on formative evaluations.
Evaluation methods: The evaluation of PBL-based learning usually includes a combination of self-evaluation, peer review by groups and teacher assessment.
Scale design: The evaluation content mainly comes from three aspects of course objectives, student participation and collaboration with group members in project activities, as well as their assessment of learning outcomes. The scale design needs to take these factors into consideration.
Through such a process, teachers can effectively guide students to master knowledge and skills of machine learning through project-based learning while cultivating their teamwork ability and problem-solving abilities. The specific assessment is shown in Table 1:

Table 1. Assessment Evaluation Form (Percentage Values)

Evaluation Subject	Weight	Score
Self-assessment	10%	
Peer evaluation	10%	
Team leader's overall evaluation	Participation 10%	
	Contribution 10%	

Instructor	Participation 20%	
	Homework completion 20%	
	Outcome presentation 20%	
Total evaluation:		

5. Results and Discussion

5.1 Analysis of Advantages of PBL Teaching Mode

According to empirical research results, the PBL teaching model shows the following advantages in core courses of big data majors:

Enhance student engagement: Students show higher levels of learning motivation and participation in PBL mode.

Promote deep learning: Students can understand and master knowledge more deeply through self-study and group discussions.

Developing comprehensive abilities: The PBL model emphasizes practice and application, which helps to cultivate students' comprehensive abilities such as critical thinking and teamwork. As shown in Figure 4:

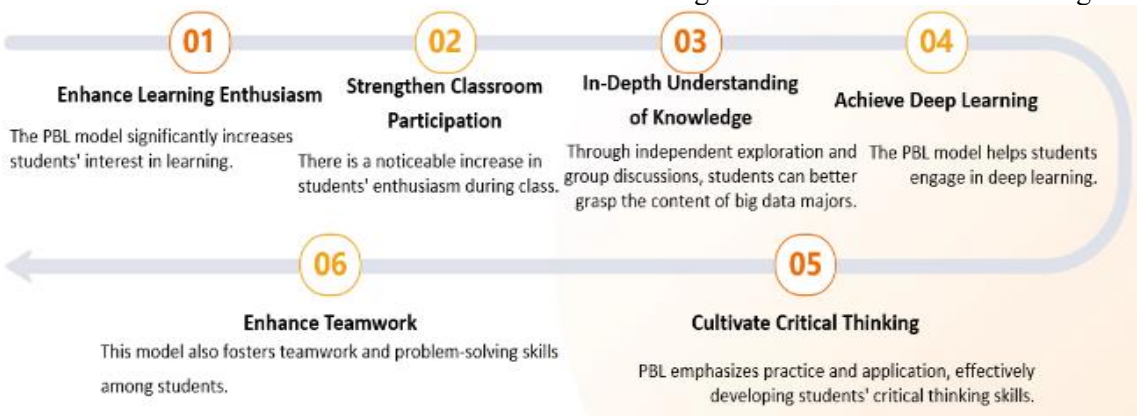

Figure 4. Advantages of PBL Teaching Mode

5.2 Challenges Encountered During Implementation

Despite its many advantages, the PBL teaching model also encountered some challenges in implementation.

Course design difficulty: Designing courses suitable for a PBL model requires teachers to have high professional competence and innovative ability.

Resource constraints: Implementing PBL requires rich learning resources and technical support, some schools may find it difficult to meet these requirements.

Teacher role transformation: In PBL mode, teachers' roles shift from knowledge transmitters to learning guides, which puts higher demands on them.

5.3 The Impact on Students' Ability Cultivation

The impact of PBL teaching model on students' ability cultivation mainly manifests in several aspects as follows.

Critical thinking: Students can develop critical thinking skills while solving practical problems.

Teamwork ability: The process of group discussion and collaborative problem solving helps to enhance students' teamwork abilities.

Problem-solving ability: The PBL model encourages students to actively seek solutions to problems, thereby improving problem-solving abilities.

6. Conclusion

6.1 Application Effect of PBL Teaching Mode in Core Course Construction for Big Data Major

According to the empirical research results of this study, the application of PBL teaching model in the construction of core courses for big data majors has achieved positive effects. Students showed higher learning motivation and engagement under the PBL mode, with significant improvements in critical thinking, teamwork, and problem-solving abilities. Additionally, the PBL mode also promoted students' deeper understanding and application capabilities of big data knowledge. The main effects of applying the PBL teaching model in the core courses for big data majors are as follows:

The experimental results show that the teaching model based on Problem-Based

Learning (PBL) has achieved significant effects in building core courses for big data majors. On one hand, students' learning interest and enthusiasm have been significantly improved; on the other hand, their problem-solving ability, teamwork skills, and innovative thinking have also been effectively enhanced. Furthermore, this mode promotes communication and interaction between teachers and students.

The movement, which has been described as a "game changer" for the classroom, enhances activity and engagement in class.

Motivation to learn is enhanced: Students show higher interest and involvement in learning activities under PBL mode.

Ability cultivation: The PBL model effectively promotes students' comprehensive ability development, especially critical thinking and teamwork.

Enhanced ability to apply knowledge: Students enhance their ability to apply theoretical knowledge in practice by solving practical problems.

6.2 Suggestions for Reforming Teaching Models

Based on the findings of this study, we propose the following teaching model reform suggestions:

Optimization of course design: further optimize PBL course design to ensure the authenticity and challenge of problems, so as to better stimulate students' learning interest.

Teacher training enhancement: Strengthen teacher training in PBL teaching mode, and improve teachers' guidance and assessment capabilities.

Resource support increase: Schools should provide more learning resources and technical support to meet the needs of the PBL model.

Evaluating mechanism is improved: Establish and improve the evaluation system of teaching effect in PBL, including self-evaluation by students, peer assessment and teacher assessment.

In summary, the application of a PBL-based teaching model in the construction of core courses for big data majors has significant advantages and effects. In the future, we will continue to deepen the application and research of the PBL teaching mode in big data majors, further improve the course system and teaching methods, and strive to cultivate more talents with solid theoretical foundations and excellent practical abilities in the field of big data. At the same time, we also look forward to discussing the innovative applications and development trends of the PBL teaching mode in higher education with more scholars and colleagues.

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