

Exploration on PBL Teaching Mode of Artificial Intelligence Technology Course in Higher Vocational Colleges

Jinren Zhu

(Electronic Information School, Zhejiang Business Technology Institute, Ningbo

Abstract:

Problem-Based Learning (PBL) is a student-centered teaching model that emphasizes practice and innovation. Engineering majors in higher vocational colleges pay attention to the cultivation of students' practical skills and innovation ability. How to cultivate students' practical innovation ability in the teaching of professional courses is one of the key issues for teachers in higher vocational colleges. This paper aims to explore how to effectively integrate PBL model into artificial intelligence technology courses, and demonstrate its effectiveness in cultivating students' innovative ability, solving practical problems and improving comprehensive ability through detailed implementation strategies and specific implementation cases, so as to provide references for the teaching of other engineering courses in higher vocational colleges.

Keywords — Problem-oriented learning, Higher vocational education, Artificial intelligence technology, Teaching strategy.

I. INTRODUCTION

Problem-based Learning (PBL) is a typical student-centered teaching approach, which situates learning within complex and meaningful problem scenarios and enables students to collaborate in groups to address the issues identified during the learning process, thereby facilitating the acquisition of the scientific knowledge concealed behind the problems and promoting the development of their self-directed learning and lifelong learning capabilities. The PBL teaching approach was initially pioneered in 1969 by the American neurology professor Barrows at McMaster University in Canada and has since emerged as a widely adopted teaching method worldwide. Teachers in numerous colleges and universities have incorporated the PBL model into their course instruction. Wang Jingwen[1] employed the PBL teaching method and the traditional teaching method respectively in the teaching of echocardiography diagnosis to educate the two groups of the ultrasound base training cohort. The practical outcomes indicated that the overall

satisfaction rate of the PBL teaching method was 94.29%, surpassing the 77.14% in the control group. Hao Jianying et al.[2] implemented the PBL teaching method in the ideological and political teaching practice of courses in higher vocational colleges, stimulating students' learning interest through joint exploration of social hot issues and achieving favorable results in enhancing students' critical thinking ability and social practice ability. Han Rui[3] applied the PBL teaching mode to the teaching of electronic and electrical majors in higher vocational colleges and verified that the PBL teaching mode enabled students to cultivate critical thinking, innovative thinking, and problem-solving skills in the process of resolving practical problems. Evidently, the essence of the PBL teaching method lies in exerting the guiding role of problems in the learning process, mobilizing students' enthusiasm for active learning, active thinking, and the improvement of innovation ability. In recent years, the OpenAI Lab in the United States has successively launched the AI language model ChatGPT and Text-to-Video large AI model SORA. Domestic technology companies have also

launched large AI models such as ERNIE Bot and Tongyi-AI. AI has gradually become the focus of global science and technology and industrial competition and is in a phase of rapid development. Its technological advancement and application expansion are constantly driving social and economic transformations. According to the statistics of the National Vocational College Professional Setup Management and Public Information Service Platform, a total of 618 higher vocational colleges nationwide have filed the major of artificial intelligence technology application (service) in 2024, accounting for nearly 40% of the country's 1,547 higher vocational colleges. As an important position for cultivating skilled talents, in the context of the rapid update and iteration of AI technology, training AI skilled talents to meet the development requirements of new-quality productivity is the main training objective of the artificial intelligence major. Regarding the teaching methods of artificial intelligence courses, many teachers and scholars in universities have conducted practical research. In the practice process of artificial intelligence + education, Shanghai Jiao Tong University has gradually advanced the innovation and reconstruction of teaching by formulating teaching guidelines for teachers, establishing a Siyuan-AI student aid platform, and allocating special funds for artificial intelligence + education. Tsinghua University has also developed vertical applications of large language models based on the characteristics of different disciplines in the pilot course of AI-enabled teaching, created diversified teaching scenarios such as intelligent teaching assistants and knowledge graphs, and deeply observed and analyzed the impact of the integration of AI technology and education and teaching. Higher vocational colleges generally offer artificial intelligence technology courses and place greater emphasis on the cultivation of students' practical ability and innovative ability. The PBL teaching mode can effectively facilitate the development of students' active learning and innovative ability. This paper will systematically discuss the teaching model of artificial intelligence technology based on PBL from the perspectives of

teaching objectives, teaching design, implementation process, and effect evaluation.

II. ARTIFICIAL INTELLIGENCE TECHNOLOGY COURSE TEACHING STATUS

The courses of artificial intelligence technology in higher vocational colleges generally introduce the basic knowledge of artificial intelligence, the foundation of Python language, the common frameworks of machine learning and deep learning, such as the application of PyTorch and TensorFlow.[4][5] Combined with the learning characteristics of higher vocational students, the content of the selected textbooks is usually more focused on practical operation. Taking a higher vocational college in Ningbo, Zhejiang province as an example, all majors in the School of Electronic Information of the school have opened artificial intelligence technology courses. After several rounds of teaching of artificial intelligence technology courses, through the investigation of teachers and students, the current teaching of artificial intelligence technology courses has the following problems: (1) The content of teaching materials usually lags behind the development of artificial intelligence technology, and the same textbook may be used for several academic years, so that most students do not learn the latest artificial intelligence technology and framework; (2) The traditional teaching mode is generally adopted in the teaching method. First explain theoretical knowledge points and then conduct targeted exercises. Of course, this teaching mode has certain effects. Most students who listen carefully can master some AI skills, but this mode makes students lack the initiative to practice and innovate, which is not conducive to the cultivation of students' independent learning ability and innovation ability. (3) The learning objectives of the course are not clear. After learning the course, many students are not clear about why they learn the course, what they can do after learning, and what corresponding positions in the workplace are competent. These problems directly lead to a lack of enthusiasm for learning. (4) Full-time teachers are rich in theoretical knowledge, but lack experience in real projects related to artificial

intelligence in enterprises, resulting in the inability to design real practical training projects for students to practice in the teaching process. The root cause of the above problems is that students are not interested in learning and do not take the initiative to learn new knowledge. In view of this, the author adopts the problem-oriented learning model to study and practice in the teaching process of artificial intelligence technology.

2. Curriculum teaching strategies and practices based on PBL

Based on the characteristics of learning conditions in higher vocational colleges, the reform and implementation of the PBL teaching mode are carried out from the aspects of teaching concept, teaching content, teaching process and teaching assessment, with the aim of cultivating students' practical innovation ability and promoting students' AI skills.

2.1 Change of teaching concept

The fundamental goal of education is to cultivate morality and cultivate people. Vocational colleges, as the main position of cultivating high-quality skilled talents, train students not only to master professional skills, but also to have the spirit of patriotism, professional spirit of love and dedication, and the spirit of craftsmanship of excellence. Under the background of vigorously developing new quality productivity, they can contribute their own strength to the great rejuvenation of the Chinese nation. The goal of the course teaching of artificial intelligence technology is to cultivate AI skilled talents with high quality, hard skills and strong innovation to meet the requirements of the development of new quality productivity. Driven by this goal, the teaching concept needs to be changed. While implanting knowledge and skills, curriculum teaching should pay attention to the cultivation of students' ideological and political moral education and professional spirit, stimulate students' learning enthusiasm to change from passive learning to active learning, and pay attention to the cultivation of students' innovative practical ability. Specifically, it is carried out from three aspects: (1) deeply integrate the curriculum ideology and politics with the artificial intelligence technology

course, deeply explore the ideological and political elements contained in the course, and achieve the effect of moral education silently while learning knowledge. In the field of artificial intelligence, comparing the scientific and technological achievements of China and the United States, introducing the large AI model and leading unmanned driving technology launched in the field of domestic artificial intelligence to enhance students' national pride and stimulate students' enthusiasm for scientific and technological innovation. In the practical training project, practical training exercises are carried out based on Baidu AI open platform, Python language is used for coding and debugging, Baidu AI open interface is invoked and source code is viewed. In the practice process, students experience the spirit of craftsmanship of excellence through the demonstration role of example. (2) Classroom teaching adopts project-based and case-based teaching methods to support and encourage students to conduct teamwork and independent learning. Set up a variety of practical training projects, guide and encourage students to conduct independent learning, study AI-related academic papers, use AI open platform, open source framework, expand knowledge channels, divergent thinking, and cultivate students' practical innovation ability. (3) Guide students to transform their knowledge and skills, participate in various vocational skills competitions, innovation and entrepreneurship competitions, Challenge Cup and other science and technology competitions, and promote the active in-depth learning of AI knowledge and skills through competitions to enhance market competitiveness.

2.2 Reconstructing course teaching content in project-based way

Artificial intelligence technology courses are generally offered in the sophomore year, with 64 class hours, including 16 theoretical class hours and 48 practical class hours. In the freshman year, students have chosen Python programming and have a certain programming foundation. According to the characteristics of vocational students' learning situation of "emphasizing practice and neglecting theory", the course content of artificial

intelligence technology is reconstructed by project based on Python language. In the form of loose-leaf teaching materials, following the principle of "from easy to difficult, step by step" and adhering to the concept of "enough theory, practice first", the course content of artificial intelligence technology is divided into seven items for reconstruction. Table 1 below shows the teaching content after the course reconstruction.

TABLE I

THE TEACHING CONTENT AFTER THE COURSE RECONSTRUCTION

Teaching Project	Teaching Content
Project 1: Python basics	Python basics syntax, combined data types, functions, etc
Project 2: Data analysis and visualization pip tool	Matplotlib library and Data Visualization
Project 3: Natural language processing	NLP interface use of Baidu AI
Project 4: Digital image processing	Anaconda3 , Using OpenCV for image processing
Project 5: Face detection and face recognition	Using OpenCV to realize face detection and recognition
Project 6: Mask wearing detection	Using PaddleHub to achieve mask wearing classification
Project 7: Face detection and face recognition	Common machine learning algorithms and using

Compared with the study of theoretical knowledge, most students in higher vocational colleges are more inclined to practical operation, and their thinking is more active. On the basis of students' existing Python programming, the reconstructed course contents pay more attention to the application ability of artificial intelligence third-party libraries, mature AI frameworks and platforms, and pay more attention to the cultivation of students' document reading ability, coding and debugging ability, team cooperation ability and innovation ability. In the course teaching, PBL teaching mode puts forward higher requirements for teachers. First, based on the learning situation, teachers should design problems that can stimulate students' learning interest, promote students' independent learning, active thinking and active innovation; The second is to group the students in the class reasonably, provide guidance in the whole teaching process, and provide support for the difficult problems that the students can not solve; Third, it is necessary to participate in the whole

process of course evaluation, introduce feedback mechanism, and constantly improve the course content.

2.3 Implementation of teaching cases

Extract the important knowledge points and skills contained in the project, and combine Baidu AI platform to design problems closely related to artificial intelligence technology for the project. The questions need to be challenging, practical and designed to stimulate students' interest and desire to explore. Take natural language processing project as an example, design question: "How to use visual tools to display customers' comments and tendency analysis on HUAWEI smart bracelet of JD Mall?". Classroom teaching is carried out according to the following flowchart 1:

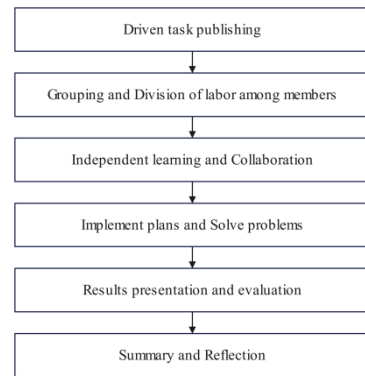


Fig.1 PBL teaching model process

- (1) Driven task publishing. The published tasks need to be able to apply the knowledge and skills of the course, be extensible and require students to complete in the form of team cooperation. For example, when learning the natural language processing module of Baidu AI, the task of commodity review view visualization comprehensively examines students' learning ability of web crawler, natural language processing, data visualization and other knowledge and skills, as well as their ability to use third-party libraries. It requires students to achieve results through teamwork in the form of division of labor. Each team member can participate in the project and play a role, stimulating and driving students' learning enthusiasm through the form of tasks.
- (2) Grouping and role allocation: According to the class size and each student's learning situation,

students are divided into several learning groups, in which roles are assigned according to their interests and expertise, such as product manager, project manager, algorithm engineer, software development, software testing, data analysis, project assistant, etc. This way of division of labor not only exercises the students' teamwork ability, but also enables them to understand and apply the knowledge more deeply.

(3) Independent learning and collaborative exploration: the teacher first tells the theoretical knowledge points of the project, and after each group has clarified the problems, the students begin to learn relevant knowledge independently, and constantly enrich their knowledge reserves through textbooks, network resources and teacher guidance. The group members then communicate and discuss based on their respective learning outcomes to jointly design solutions. For example, in this task, middle school students need to learn related knowledge of web crawler, natural language processing, data visualization, commonly used open source frameworks, tools, etc.

(4) Program implementation and testing, students use the knowledge, combined with practical problems, start to implement the program. During the implementation process, they continuously test and optimize until the desired results are achieved. In the process of implementation and testing, teachers provide targeted guidance for common problems.

(5) Display and evaluation of results. After the completion of the project, each team will display the results. Teachers and other groups evaluate the results and make suggestions for improvement. This process not only exercises students' expressive skills, but also enables them to look at their own work from different perspectives.

2.4 Analysis of teaching case results

Through problem-oriented learning, students master the basic knowledge of natural language processing in the process of practical problem solving, and improve the ability of teamwork, innovative thinking and problem solving.

(1) Task-driven, significantly improved professional skills

The comprehensive ability of students to access Baidu AI development platform, document viewing, project coding, interface invocation, coding debugging, document generation and so on was investigated. Figure 2 below shows the effect diagram of one group, with excellent results.

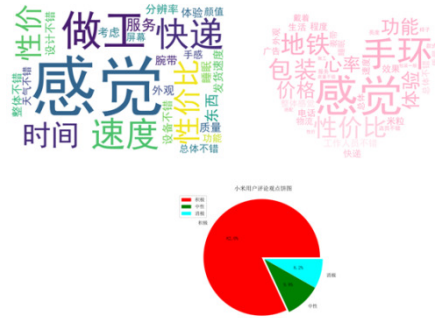


Fig.2 Student work of product review data visualization

(2) Independent learning, innovation ability gradually enhanced

Each group independently learned web crawler technology[6], acquisition software, Baidu AI document, Matplotlib library[7], word cloud map, etc., providing different display effects. In the implementation process, students took the initiative to consult materials, view documents, and learn new technologies, and the results achieved would stimulate students' interest in further learning technologies.

(3) Excellence, craftsman spirit gradually formed

In order to solve the problem, each group has a clear division of labor, each has its own role, and is working towards the same goal. Each team member is completing the assigned task carefully. Demand analysis, climbing data, viewing documents, writing code, debugging, data analysis, writing documents, etc. In the process of problem solving, students can realize that as an engineer, they need to be dedicated and strive for excellence, and the craftsman spirit is gradually formed.

2.5 Construction of teaching resources

Use the teaching resources provided by the Superstar platform of the course, including project knowledge points, videos, cases, exercises, etc. AI services provided by Baidu AI open platform and corresponding technical documents; Introduce the

latest AI tools and libraries, such as TensorFlow, PyTorch, etc., for students to practice.

2.6 Diversified curriculum assessment and evaluation mechanism

The comprehensive score of the course is composed of the regular score and the final score in the ratio of 6:4. The regular score is evaluated quantitatively in the form of a project in the ratio of 4:2:2:2 from four aspects such as knowledge and skills mastery, teamwork, innovative thinking and problem-solving ability. The teacher records the score according to the project, and the final assessment adopts the "theory + practice" method. At the same time, the course evaluation mechanism is introduced[8], the feedback of students on the course is obtained by means of questionnaire survey on a regular basis, the classroom opinions of teachers are listened to, and new teaching skills and methods are studied to improve the quality of classroom teaching through multiple channels and methods.

III. REFLECTION ON CURRICULUM TEACHING

The teaching mode of problem-oriented learning emphasizes on stimulating students' learning interest and participation through solving specific problems, and cultivating students' independent learning ability and innovation ability. In the concrete implementation process, it is necessary to take the students as the center, give full play to the initiative of students, encourage students to work in a team, independent learning, and put forward innovative solutions to solve practical problems. After three rounds of course teaching, the author believes that continuous improvement should not be made in teaching practice in the following three aspects: (1) The questions designed by teachers are very important and need to come from actual projects and be closely combined with curriculum knowledge and skills, which can stimulate students' interest in learning and exploration, enable students to obtain phased results, and realize the sense of harvest after efforts. Teachers need to actively participate in AI technology practice, carry out school-enterprise horizontal project cooperation, and improve their skills in project development. (2) It is necessary to pay attention to the completion of

tasks of each group throughout the whole process, evaluate the learning effect of members in the group, and make dynamic adjustments. (3) Integrate more ideological and political elements into the curriculum, excavate the ideological and political elements contained in the curriculum, achieve the same direction of professional courses and ideological and political courses, and cultivate students' feelings of home and country, professional spirit of love and dedication, and craftsman spirit of excellence.

IV. CONCLUSIONS

With the rapid development of artificial intelligence technology, products based on artificial intelligence have been widely used in all walks of life, promoting economic development and affecting people's lives. As the cradle of training skilled talents, higher vocational colleges should adapt to the trend of The Times and train innovative practical talents with artificial intelligence thinking and skills for national construction. In the teaching process of artificial intelligence technology courses, problem-oriented learning is adopted, student-centered, and team cooperation, independent learning, and summary are adopted in the form of project to enhance students' team ability and innovation ability in the process of continuous practice. Of course, in the implementation process, there are also cases in which individual students do not actively participate and the content of the practical training needs to be improved, which is also the continuous improvement in the subsequent teaching process and the driving force of teaching reform.

REFERENCES

- [1] Wang Jingwen. The role of PBL teaching method in the diagnosis teaching of echocardiography [J]. *Imaging Research and Medical Applications*, 2019,8(14):191-193.
- [2] Hao Jianying, Zhao Ruofan. Research on Curriculum Ideological and Political Teaching in Higher Vocational Colleges under PBL teaching Model -- A case study of Baiyin Mining and Metallurgy Vocational and

- Technical College [J]. *Modern Vocational Education*,2024,(20):153-156.
- [3] HAN Rui. Research on Application of PBL Teaching Mode in Electronic and Electrical Teaching in Higher Vocational Colleges [J]. *Theoretical Research and Practice of innovation and Entrepreneurship*, 2019,7(14):165-167.
- [4] Wang Jingwen, ZHANG Simeng, Qi Wei. Application of PyTorch and Open source Data Mining Tools in Artificial Intelligence teaching [J]. *Computer Knowledge and Technology*, 2019,19(26):162-164.
- [5] Pan Wenchan, Huang Haiping. Construction and research of TensorFlow Platform based on Artificial Intelligence [J]. *Laboratory Science*,2023,26(04):44-47.
- [6] Sheng Jing, Xu Chao, Zhou Tao. Analysis of Python web crawler technology [J]. *China Information Industry*,2024,(06):210-212.
- [7] Zhang Yuye, Li Xia. Data analysis and visualization based on Pandas+Matplotlib [J]. *Journal of Shandong Open University*,2023,(03):75-78.
- [8] Liu Xiping, Jiao Xianpei, Luo Sven, et al. Exploration and practice of course evaluation mechanism based on the concept of Engineering education Certification: A case study of "Fundamentals of Programming" course [J]. *Electronic Components and Information Technology*,202,6(01):189-191.