



# Research on the Design of the Online and Offline Teaching Workshop Platform of Higher Vocational PBL Based on Big Data Technology

Lanhua Guo<sup>(✉)</sup> and Weixin Zhen

Shandong Vocational College of Science and Technology, Weifang, Shandong, China  
glh19720806@163.com

**Abstract.** Aiming at the small learning social scope for learning in current higher vocational education, insufficient resources, and low learning efficiency of academic conditions, an online and offline teaching workshop platform of higher vocational PBL based on big data technology is designed. Firstly, according to the problems existing in traditional PBL teaching, a PBL teaching network system is constructed by using Internet and B/S browser architecture, which includes user layer, functional logic layer and physical storage layer. Then, the SQL Server database is established in the system, through which the system is tested. The test and verification show that the proportion of the respondents who are very satisfied with the application of the system is about 14.79%, and the application effect of the system is good. It indicates that the established online and offline teaching platform of PBL of big data network can increase students' learning resources, expand the scope of learning social groups, make students more self-conscious and active in learning, and enhance their ability to learn and solve problems independently.

**Keywords:** Academic status · Big data technology · PBL · SQL Server database

## 1 Introduction

With the gradual development of the economic strength and technological level in China, computer network technology has already penetrated into every aspect of life. It has been involved in science and technology, education, finance, and medical treatment. Traditional teaching methods can no longer meet the current development of higher vocational education. In traditional culture teaching, teachers teach students mainly through multimedia technologies such as blackboards and computer PPT. This kind of teaching method has been widely used in the teaching field, but there are still problems such as repetitive teaching methods, low teaching quality and restraining students' creativity and imagination, which is not conducive to the long-term development of current teaching. In response to this problem, scholars have conducted a lot of research. Yang Yonghua took Sichuan Mechanical and Electrical college as the research object, proposed to use the PBL method to build an online teaching platform. Experiments have found that the platform conducts in-depth mining of students' information through data

mining algorithms, and classifies students' information through clustering algorithms, realizing personalized online teaching of students [1]; In order to improve the effect of online and offline teaching in colleges and universities, Liu Han proposed a regional economics method based on PBL, which combines the learning methods of online and offline courses and provides targeted teaching guidance to students [2]; In order to realize the effective evaluation of higher vocational education, Li Weimin et al. proposed a hybrid teaching model, through which the higher vocational rehabilitation assessment technology is applied, and it has certain feasibility [3]. However, although the above scholars' research has achieved certain application results, in higher vocational teaching, there are still problems such as single teaching methods and insufficient teaching resources in higher vocational teaching, which cannot effectively improve the learning efficiency. Based on this, combined with the research experience of the above scholars, a PBL online and offline teaching platform based on the big data network environment is established. The content that students are interested in is obtained through the big data technology, and the information is stored and matched through the database, so as to use this system to carry out personalized teaching for students. In this way, the learning resources is increased, the scope of learning is expanded, and the learning efficiency is improved.

## 2 Overall Architecture Design of PBL Teaching System

Among a variety of efficient online learning, a teaching method that is suitable for students to deeply feel the learning atmosphere is called PBL teaching method (problem-based learning). This kind of teaching method is mainly to ask questions or customize goals for learning, and it gained great strength and promotion in the field of education all over the world [4]. The main meaning of PBL teaching method is based on the teaching mode of students-oriented questions in the real learning classroom. This teaching mode can improve the ability of vocational students to learn independently, improve their imagination and thinking ability, and can help them independently solve problems when they encounter difficulties, and obtain professional theoretical knowledge from it, thereby improving their practical ability.

There are two PBL teaching methods in the big data network environment. One is to obtain information through the Internet network when students learn. This method only uses the Internet as a tool to transmit knowledge; The other is completely relying on the Internet for open learning, it can not only teach, but also communicate on the network platform, such as the current popular web-cast teaching [5]. PBL mainly focuses on three basic elements: students, teachers, and problems. Questions are the key, whether asked by students or teachers, and then students find ways to solve problems. Teachers can give guidance to help students solve problems and find answers.

The design of the PBL network architecture system is mainly divided into three levels. The first layer is the user layer, which belongs to the client and is mainly used for user input. The platform user roles include students and teachers [6]. The user role enters the function logic layer of the key layer server by opening the computer browser Internet network to search, which mainly includes four modules, namely function management, teacher module, student module and interactive communication module [7].

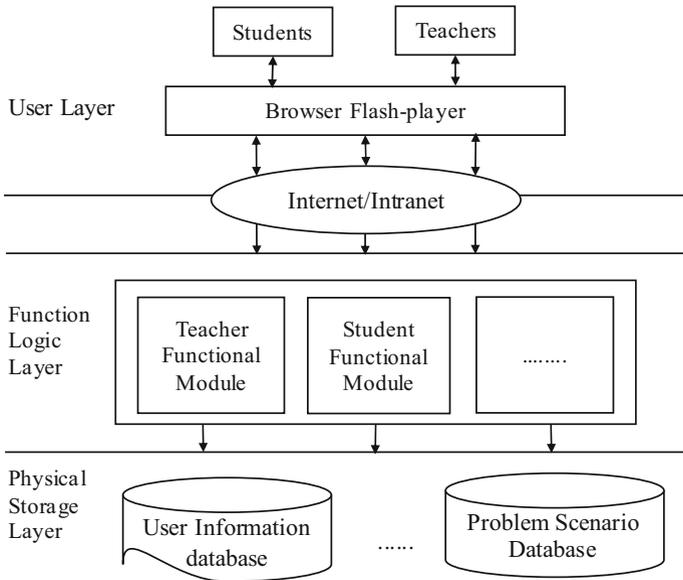


Fig. 1. The overall framework of PBL teaching platform

Further, it can go to the user information database and problem scenario database in the server physical storage layer. This layer mainly manages and stores the data sent by the system. The main system logic is shown in Fig. 1.

### 3 Set Up the Development Environment of PBL Network Teaching System

#### 3.1 System Development Architecture

To develop the PBL network teaching system, the first step is to build an environment suitable for the PBL network. The following uses integration SSH (Struts+Spring+Hibernate) system development software framework, selecting lightweight Java website [8].

In the system development software framework, the SSH architecture is a B/S (Browser/Server) browser architecture that can be divided into three levels. Struts in the presentation layer mainly controls the display and logical sequence of the system front desk. The main function of business layer Spring is to separate the logical sequence of the business, which can improve the stability and reparability of the system [9]. The persistence layer Hibernate maintains the data and processes it through the oriented system layer database.

### 3.2 MyEclipse Integrated SSH

The overall framework of SSH (Struts+Spring+Hibernate) system development software is mainly composed of five programs including MyEclipse integrated development environment, application server Tomcat, adding Struts and Hibernate, and Spring development functions [10].

In the PBL network teaching system, SSH is expanded by the plug-in MyEclipse in Eclipse. Eclipse is an open source code, and a system development platform can be continuously developed on the basis of Java. The MyEclipse integrated development system is fully functional and easy to install. It mainly includes complete coding, which can debug the system, test and release the main functions [11]. Supports HTML in the system development software framework, presentation layer Struts, business layer Spring, etc.

### 3.3 Database Platform SQL Server

Computers were commonly used in data management, and data sharing and processing requirements became more and more complex, and traditional database management systems were no longer practical. Therefore, a database management system (DataBase Management System) was designed, which can perform unified classification and management of the existing miscellaneous and cumbersome data [12]. The relational database SQL Server is developed on the multi-user computer operating system UNIX platform, and SQL Server is developed on the new technology Windows NT platform [13].

Needing to establish a database platform using SQL Server 2005 system, this system is mainly set up 6 versions according to the needs of different enterprises and individuals, mainly including the most comprehensive enterprise version which can solve complex data problems; standard version for small and medium-sized enterprises; work-group version that is applicable for small enterprises; development version for supply developers; and also streamlined version and compressed version of mobile version which are applicable for low-end developer and user, etc. In the system display interface, the unified management tool SQL Server Management Studio is used to access, configure and manage SQL Server 2005 system components [14]. This tool includes two: One is to manage images, referred to as image resource manager, and the other is editor, to view and analyze acquired data, referred to as view analyzer. In the system database, the system is divided into three types: problem type, solution type and management type. The function of the problem class is to design a creative scene for the proposed problem, and to save the problems and data that appear in the scene. The function of the solving class is to solve the problem, calculate the answer, and store the data and information in the learning. The management class is to manage and save the various function information of the system.

## 4 System Implementation and Application Testing

### 4.1 Main Function Implementation

To realize the main functions of the PBL network teaching system, firstly by asking questions, users log in on the system and confirm the roles. The role of the question class is to design a creative scene for the question raised, and users use the online editor CKeditor to upload and save data for problems that occur in the network scene.

Second is group management. After the user uploads and saves the preset scenes of the problem, it enters an important link in the PBL network teaching system, that is, irregular or regular grouping of students, allowing students to organize and collect data according to the questions raised, independently learn to find solutions to problems. Again, to facilitate group management, a web development technology for creating interactive web applications is used for dynamic management of student lists [15].

Teaching system resource management. In the PBL online and offline teaching system under the network environment, the resource management module consists of three modules: the system data resource library, the learning tool section and the self-searchable program. Legal users can see resources of these three modules in this system.

### 4.2 PBL Network System Function Test and Experimental Effect Analysis

#### 4.2.1 PBL Network System Function Test

In order to obtain more accurate experimental results, the research is to conduct functional tests and experiments on the PBL online and offline teaching platform system under the network environment, and use the program software to display it in a waterfall-shaped model. The advantage of this model is that the system defects can be found and dealt with in advance. The route is mainly divided into five parts, including requirements formulation, analysis architecture, database system design, model development, and functional testing. Through these five steps, the system is verified and tested to see whether its functions, attributes, schemes, etc. are applicable.

There are many software testing methods, which generally include testing the user interface, the main functions of the system, system robustness, system performance testing, etc. This research mainly chooses system function testing to verify the system.

The function test of PBL network teaching system usually uses the black box test method. Its application is mainly to input data in the system and observe whether the output data is consistent with the target expected value. Inconsistencies indicate that the function test is unqualified. In the PBL network teaching system function test, understanding the function and business process is as shown in Table 1 using the user log-in test table.

**Table 1.** Use user log-in test form

Testing example	Expected results	Actual results
User's name or password is empty	The front desk prompts that the user's name or password is error	Desired outcome (show error messages)
User's name is error	Background judgment, show no such user	Desired outcome (show error messages)
User's name is correct, password is error	Background judgment, show error password	Desired outcome (show error messages)
User's name is correct, password is correct	Background judgment, show successful log-in	Desired outcome (turn to the main page)

The above test using user's log-in shows that the final expected target results and actual results obtained in each functional test case of the system have reached expectations, indicating that this functional test method is feasible.

Through the above test, the following calculation formulas for students' computational thinking are obtained:

$$PCT = F(T, S, P, CT)$$

Among them, PCT represents the PBL online and offline teaching mode of students' computational thinking; T represents the teaching range of teachers; S represents the learning range of students; P represents the questions raised by teachers or students; CT means students' computational thinking; F() is the function obtained through calculation in PBL network teaching above the computational thinking.

In a real classroom, the more real and clearer the question P is, the easier it is for students to find answers and solve problems with the guidance and help of the teacher.

$$T = \{A_z, A_c, A_p, A_y, A_m, CT_1\} \tag{1}$$

In formula 1, Az is the preparatory work done by the teacher before teaching; Ac is the situation in which the teacher or student creates towards the problem; Ap is the data that appears in the problem generation process; Ay is the teacher instructing the student to think; Am represents the teacher's evaluation of the final results of the students; CT1 represents that the teacher will assist the students to learn independently according to the characteristics of the students' computational thinking, and improve the students' ability of independent thinking and autonomous learning.

$$S = \{S_z, S_t, S_g, S_k, S_j, CT_2\} \tag{2}$$

The S number in formula 2 corresponds to the T in formula 1, and after different calculations, formula 3 is finally obtained

$$\begin{aligned} X_1 &= X_1 + X_2 + X_3 + X_4 + X_5 \\ Q_s &= Q_1 + Q_2 + Q_3 + Q_4 + Q_5 \end{aligned} \tag{3}$$

**Table 2.** Statistical Table of Communication Ability Data

Questionnaire options	Class	Strongly agree	Agree	Not sure	Disagree
Like to communicate with classmates, willing to share ideas with others	Experimental	14.79%	61.35%	19.21%	4.65%
	Regular	2.51%	21.75%	45.53%	32.21%
Willing to listen to and adopt others' opinions during studying	Experimental	18.34%	50.85%	23.43%	7.31%
	Regular	4.52%	19.16%	46.08%	30.24%
Willing to initially take responsibility in group tasks	Experimental	15.12%	48.17%	25.48%	11.23%
	Regular	14.35%	20.83%	42.37%	22.45%

It can be seen from formulas 1, 2, and 3 that using PBL online and offline teaching methods under the network environment, teachers can guide students according to different thinking modes, which can improve students' creativity and independent problem-solving ability.

#### 4.2.2 Application Effect Analysis

Through the above tests, the application effects of the PBL teaching system platform are compared and analyzed in three ways, which are the analysis of the questionnaire survey results, the analysis of the recognition of the PBL teaching platform, and the final score analysis.

Analysis of the results of the questionnaire survey. Through statistical analysis of the students' learning interest, communication and resource acquisition data, the specific statistics are shown in Table 2.

Analysis of the recognition of the PBL teaching platform. Through the questionnaire on the students' learning interest, communication and resource acquisition data, it is concluded that the students in the experimental class are better than the regular class in terms of learning interest, communication skills between classmates, and access to resources, indicating that the PBL online and offline teaching method based on big data can improve students' interest in learning and students' communication skills, increase students' acquisition of resources in learning, and enrich and diverse learning content.

Comparative analysis of results. By comparing the final results of the experimental class and the regular class, it can be seen that the final score comparison shows that the number of excellent and good students in the experimental class is higher than that of the regular class, and the number of passing and failing is less than that of the regular class. It can be seen that the PBL online and offline teaching system based on the network environment is feasible and promising.

## 5 Conclusion

Experiments have proved that the establishment of a higher vocational PBL online and offline teaching platform system based on big data technology can improve students'

learning interest and communication skills, expand learning social scope and independent learning ability, and also increase the diversity of system resource databases. It shows that the PBL teaching system under the network environment is suitable for higher vocational learning.

**Acknowledgments.** This paper is the phased achievement of the project “Research on the design of PBL online and offline teaching workshop in Higher Vocational Education” (Project No.: 2020zc339) of Shandong Education Science “13th five year plan” in 2020.

## References

1. Yang Y (2012) Design and implementation of the network teaching platform of Sichuan Mechanical and Electrical Vocational and Technical College based on PBL. University of Electronic Science and Technology of China
2. Liu H (2019) Research on the “online + offline” teaching method of regional economics based on PBL. *J Chongqing Univ Arts Sci (Soc Sci Edn)* 38(02):118–125
3. Li W, Liu Q (2019) The application of blended teaching mode in the teaching of rehabilitation assessment techniques. *J Jiujiang Univ (Nat Sci Edn)* 34(02):16–19
4. Chen Y, Xiao H, Liu Z et al (2019) A teaching reform attempt to create a “golden course” of online and offline hybrid metal technology. *China Metallurgical Educ* (06):5–9
5. Zhou Q (2019) An empirical study on the teaching effect of courses based on the integration of platform and “PBL”——Taking “Financial Accounting Practice” as an example. *J Ezhou Univ* 26(06):81–84
6. Ou Y, Wei X, Zhao C (2021) The design and teaching practice of engineering practical training teaching system based on intelligent manufacturing. *Electron Prod* (12):55–57+62
7. Song M, Hai Y, Cao L et al (2020) Exploration of online blended teaching in the teaching of orthopedics and traumatology of traditional Chinese medicine under the background of epidemic situation. *J Gansu Univ Tradit Chin Med* 37(03):104–107
8. Zhang J, Zhang P (2020) The construction and application of online and offline hybrid gold courses of medical genetics from the perspective of information technology. *Chem Life* 40(08):1442–1446
9. Zuo X (2021) Design of advanced mathematics assisted teaching system based on fusion particle swarm optimization. *J Jilin Univ Chem Technol* 38(05):80–84
10. Liu Y, Zhang B, Wang L et al (2020) Hybrid “Golden Lesson” teaching based on flipped classroom-PBL——taking “Drug Analysis” as an example. *Chem Educ (Chin Engl)* 41(20):92–97
11. Dong P (2020) Big data analysis and application based on “one level and three ends” intelligent teaching system. *J Hebei Northern Univ (Nat Sci Edn)* 36(03):1–7
12. Chen Y, Guo W, Xu Y, et al (2020) Intelligent teaching system based on mobile learning concept. *Comput Educ* (05):89–92+96
13. Xu Y (2020) Design of personalized intelligent teaching system under the background of big data. *Mod Electron Technol* 43(13):180–182+186
14. Liang W, Zhang H, Chen H et al (2020) Research on blended teaching based on learners’ satisfaction. *Mod Educ Technol* 30(10):112–118
15. Liu Y (2021) Innovative strategy of integrating data recommendation algorithm into live teaching. *J Shijiazhuang Univ* 23(03):39–43

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

