

Reform of Blended Online and Offline Teaching in the Object-oriented Programming Course

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Abstract: The article focuses on the characteristics of object-oriented programming courses and the problems in blended online and offline teaching, and integrates PBL (Problem Based Learning) method to carry out curriculum teaching reform. Firstly, a blended learning model based on PBL was designed, integrating problem exploration and resolution into various stages of blended learning to provide better goal guidance and process guidance. Through process testing and assessment of each stage and teaching activity, the learning progress and effectiveness of students were fully grasped, and the teaching plan was adjusted accordingly to form mutual feedback in each stage. Subsequently, the teaching objectives were clarified, the teaching content was innovated and reconstructed, and the teaching implementation process and methods based on this teaching model were standardized. Finally, the effectiveness and feasibility of this model were verified through the analysis and discussion of the implementation effect of teaching reform.

Keywords: PBL; Blended Learning; Teaching Mode; Teaching Reform; Programming

1. Introduction

Object oriented programming is a fundamental course in computer science majors. By learning object-oriented design concepts and programming techniques, students can develop strong software design and development abilities, which plays an important role in the talent cultivation system. The difficulty of course teaching lies in how to cultivate students' engineering practical abilities in schools. A large number of teaching practices have verified that reforming the teaching mode to improve teaching effectiveness is an

important way to solve this problem^[1-3]. With the rapid development of artificial intelligence and internet technology, the dissemination and circulation of information are becoming increasingly rapid, which provides a wider range of channels for knowledge dissemination. In recent years, the online and offline teaching mode based on "Internet plus education" has been widely used, and online education has become an integral part of traditional classroom education. Online teaching platforms can break through time and geographical limitations, allowing students of different levels to selectively learn and watch repeatedly anytime and anywhere, which helps to enhance their self-learning ability, critical thinking ability, and innovative thinking ability. Online teaching platforms usually provide rich teaching tools, which not only provide more interactive channels, but also collect data during the teaching process, organize, analyze, and visualize it, helping teachers better monitor the teaching process and assist in refining teaching decisions. With the help of online platforms and modern information technology, teachers can create rich teaching activities, implement personalized guidance and diversified evaluation of the learning process, and inspire and guide students from different dimensions^[4].

The introduction of blended learning provides greater innovation space for curriculum reform. However, there are also some problems in teaching practice, such as students often getting stuck in the details of individual knowledge points during online self-directed learning, lacking control over the internal logic of knowledge, which makes it difficult to explore and control the overall structure of knowledge. In addition, there are differences in students' self-restraint and learning abilities, leading to differentiation in the effectiveness of self-directed learning, affecting the implementation of offline classroom teaching

plans, and further affecting the arrangement of online learning tasks, which may lead to a vicious cycle, making teaching effectiveness still highly dependent on classroom teaching and failing to achieve the expected results of blended learning.

Therefore, in the teaching practice of blended learning, how to design effective teaching modes, combine with innovative classroom teaching design, guide students' self-learning, and enhance their adaptive ability is the key to leveraging the advantages of blended learning.

2. PBL Based Blended Learning Mode

Problem Based Learning (PBL) is a problem-oriented teaching method that emphasizes that students acquire knowledge through autonomy and collaboration in the process of posing and solving problems, apply theory to practical projects, and cultivate their personal and collaborative abilities [5-6]. The core of PBL is problem oriented, stimulating students' interest and motivation in active learning and exploration, guiding them to actively cross integrate multidisciplinary knowledge based on problem scenarios, and explore innovative solutions that can solve problems through self-directed learning and team cooperation [7]. PBL has been widely applied in course teaching design in various disciplines. Combining PBL with blended online and offline teaching can fully leverage the advantages of both and

improve students' learning outcomes and practical abilities [8-10].

In the course of object-oriented programming, students' ability to understand object-oriented thinking and apply it to problem domains, analyze, design, and implement problems is the core goal of course teaching. The problem oriented PBL is precisely the response plan that adapts to this goal. Integrating PBL with blended learning can complement each other and is a teaching model worth exploring. Blended learning emphasizes students' self-directed learning, collaborative learning, and personalized learning, which run through various stages of the teaching process. Integrating PBL with various aspects of blended learning can better provide goal guidance and process guidance.

This course is based on the idea of PBL and adopts a learning platform to build teaching resources such as a teaching database, exercise library, and case library. PBL integration methods are designed for each process of blended learning. The online platform mainly provides learning resources, auxiliary teaching support, and data statistical analysis. In offline classrooms, various learning activities are organized based on online learning to achieve knowledge consolidation and deepening. The entire process can be monitored, detected, and feedback can be provided, as shown in Figure 1.

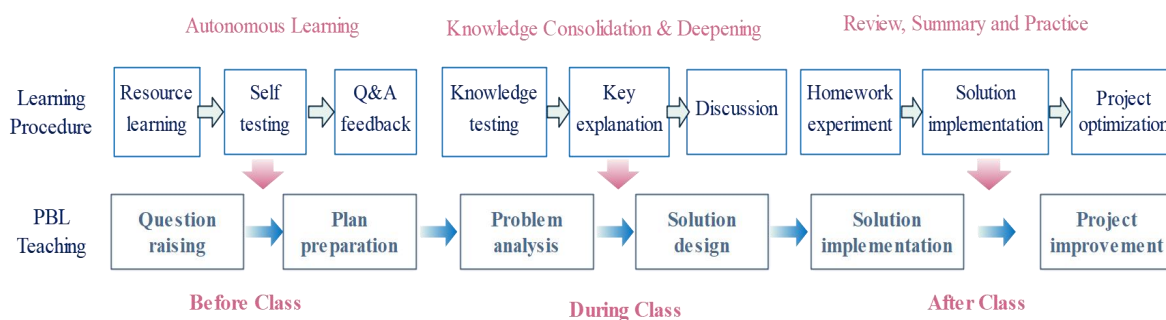


Figure 1. PBL Based Blended Learning Model

In the pre class section, the main content is for students to explore first and carry out adaptive learning. Teachers pre publish task lists, teaching materials, and group students on the learning platform, and monitor and guide the learning process of students. They can also participate in student discussions and answer common questions appropriately. The course task is a project with a certain problem background designed based on teaching

objectives and combined with engineering practice, with varying sizes. According to unit learning objectives, students can conduct learning individually or in groups, with the goal of solving problems. This way, the learning purpose and motivation are stronger.

After online self-directed learning, students enter the classroom with questions. Teachers analyze the pre class learning process data of students through online platforms, summarize

and explain the common problems, difficulties, and weak points that students face in exploratory learning, guide students to discuss practical problems in project implementation, stimulate students' interest in participation, and through carefully designed classroom learning activities, teachers and students engage in efficient discussions or exercises, while solving knowledge learning problems, achieving knowledge deepening and expansion^[4]. An important aspect of classroom learning activities is exam. It is necessary to check the pre class learning status to adjust classroom arrangements, as well as to conduct summary checks on the learning status in the later stages of classroom teaching. By comparing and analyzing the test results, teachers can adjust the teaching content in a timely manner and assign the next self-directed learning task.

How to internalize and absorb knowledge, and transform it into the ability to design solutions and implement programs in practical problems, is the key to applying PBL. Therefore, in the post class stage, teachers should design tasks that are practical and incorporate innovative elements based on the teaching content, and release them to students. These tasks often span multiple learning units, linking knowledge from one stage or module together. The teacher provides the goals, plans, implementation process, and methods for the task. During the process of exploring, designing, and developing tasks, students achieve the transformation of knowledge into abilities. Teachers monitor and follow up on the process of task implementation, guide students on how to break down tasks, collaborate, and design plans, and timely help students clear major obstacles in the process to ensure smooth progress. After completing the task, summarize and reflect on the implementation of the task in combination with the classroom report and defense activities. Based on the summary and feedback from students on the task, teachers adjust the course tasks and teaching progress in a timely manner, optimize the teaching content, and design targeted teaching activities to achieve feedback goals.

3. Implementation of Teaching Reform

The teaching reform aims to comprehensively utilize online and offline teaching resources, innovate and reconstruct teaching content, combine PBL hybrid mode, stimulate students'

interest and motivation in active thinking and learning, and finally, through process testing and assessment of each link and teaching activity, fully grasp students' learning progress and effectiveness, and adjust teaching plans accordingly, forming mutual feedback in each link.

3.1 Teaching Objectives

The teaching objectives of the course are defined as three abilities: learning the basic concepts, ideas, and design methods of object-oriented thinking, and mastering the expression and implementation methods of object-oriented thinking; Master Java programming technology, be able to design the basic architecture of the system according to user needs, and independently use Java technology for object-oriented small software design and development; Has good self-learning, analytical, and problem-solving abilities, independent thinking and innovation awareness, as well as team communication skills and collaborative spirit.

3.2 Course Content Reconstruction

Starting from the course objectives, design the course content system into four parts: fundamentals of Programming, object oriented programming techniques, practical Java technologies, and application of development technologies.

The "Fundamentals of Programming" section is a review of students' previous programming language learning and also a connection with Java language learning. On this basis, gradually transition to the second part, learn the basic concepts and programming methods of object-oriented, so as to master the methods of expressing and implementing object-oriented ideas, and initially form awareness of software analysis and design; After starting the "Java Practical Technology" section, you can use commonly used techniques to analyze and handle more complex problems, further training and improving object-oriented design and implementation capabilities; Finally, through the learning of the "Application Development Technology" section, one can design the basic architecture of the system according to user needs, and comprehensively use Java technology for the design and development of small application software.

Throughout the entire teaching process, the design, development, and continuous evolution

of a bank account management system were used as course cases to gradually deepen students' understanding of the application of object-oriented methods.

3.3 Blended Learning Process

The blended learning process mainly includes three stages: pre class, classroom, and post class, and combined with the teaching platform, provides resource sharing, process evaluation, and feedback to support the course objectives.

(1) Before class: Preparation of knowledge before class. Students carry out online self-learning and task exploration activities according to the assigned learning tasks. Online resources include courseware, lecture notes, reading materials, technical manuals, videos, experimental guidance, assignments, course tasks, learning assessments, etc. Online, students can view their learning progress, grade assignments, and provide timely feedback and results.

(2) Classroom teaching: problem oriented, with course task development as the goal, to explain the key and difficult points, analyze and summarize the problems in learning and practice, guide students to form a plan for developing practical tasks, and make technical reserves, so as to cultivate system analysis, software design, and implementation abilities oriented towards problem requirements under project driving.

(3) After class: Students can repeatedly review or search for online resources to deepen and consolidate their knowledge. Through a series of hierarchical practical tasks, students can be encouraged to explore and carry out tasks independently, further internalizing object-oriented knowledge and design and development skills. During the process of group tasks, students also need to engage in discussions and cooperation after class, and sometimes teachers need to participate in providing guidance to improve the quality and efficiency of group project implementation.

3.4 Teaching Methods

In terms of teaching methods, scientific research projects or engineering cases are effectively transformed into course cases and course projects, and PBL combined with case teaching method is used for teaching.

Through case teaching, guide students to analyze, discuss, and summarize practical problems, improve their ability to understand, analyze, and

solve problems. Analyze cases with related relationships, guide students to expand or modify one object-oriented case into a solution for another, and cultivate their ability to solve practical problems. At the same time, combining heuristic teaching methods, guiding students to actively learn, creating opportunities and conditions for independent thinking, analysis, and problem-solving, and cultivating their self-learning and innovative abilities. The course focuses on several key content related to design, such as class design, inheritance, and polymorphism. Several examples are selected to explain and practice the design and development of small systems such as poker games, user management systems, and product management systems. In terms of practical teaching, students consolidate and practice theoretical knowledge through experiments, arrange case studies after each chapter, and then imitate cases to carry out confirmatory practice. Based on this, students carry out PBL based project course practical projects in small groups.

3.5 Implementation Effect

The blended online and offline teaching mode has been implemented among students majoring in Information and Computational Science in the 2021 cohort. The implementation results show that students' learning enthusiasm, online participation, and classroom activity have significantly improved. The quality of homework and course projects has also been significantly improved, and the programming ability has been greatly improved. It can be seen that this teaching mode has played a significant role in improving teaching quality.

A questionnaire survey was conducted on 90 students who chose to take this course in the 2022 academic year to understand their satisfaction with the new teaching model. The survey results show that over 90% of students are satisfied with the teaching effectiveness of the course and believe that this blended online and offline teaching model is very helpful in improving software design and implementation abilities as well as team collaboration abilities.

4. Conclusions

Object oriented programming is a highly practical course, and engineering practice also requires students to be able to flexibly use relevant knowledge to analyze and solve practical problems. In the teaching of object

oriented programming, PBL based teaching mode combines online and offline teaching, with the support of various auxiliary tools of online teaching platform, to explore an online and offline hybrid teaching mode based on Internet plus. In practice, blended learning requires targeted reforms that combine course objectives and student characteristics, in order to effectively promote teaching innovation and progress.

Curriculum and teaching reform and innovation need to be continuously carried out. In the future, it is necessary to further improve the content and quantity of online learning resources, and combine engineering practice to tailor and design high-quality course practice tasks to ensure the teaching quality of blended learning.

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