Original Research Article

Exploration and Practice of Blended Teaching in Computer Programming Practice Courses from the Perspective of Golden Courses

Abstract: The blended teaching approach in the context of smart education environments fully embodies the teaching philosophy of student-centered and teacher-guided learning, which is an important way to enhance the quality of teaching. As one of the five types of "gold courses," the blended online-offline golden course has a significant impact on improving students' learning abilities. This paper investigates the current issues in blended teaching of computer programming practice courses, such as insufficient integration of ideological and political education, weak operability of practical course objectives, and the lack of systematic design in blended teaching and evaluation. It proposes measures for teaching reform: in line with the "101 Plan" for cultivating top innovative talents at the national level, clarify the construction goals of computer programming practice courses; establish a teaching innovation team and construct a blended teaching reform model; develop high-level, challenging, and three-dimensional teaching resources; empower numerical intelligence in smart environments to reshape the teaching process; and link teachers with AI to continuously optimize teaching outcomes. Through systematic teaching reform, computer programming practice courses have significantly enhanced students' learning willingness, learning methods, project engineering practical abilities, and innovative capabilities.
Keywords: Gold Courses, Blended Learning, Programming Practice, Evaluation, Human-Machine Collaboration

Introduction

Undergraduate education is an important way to cultivate talents for various fields in future society. The quality of teaching directly affects the quality and quantity of talents cultivated, and further influences the overall progress and development of society. In June 2018, the concept of "Golden Courses" was proposed at the National Conference on Undergraduate Education in Colleges and Universities, with the core aim of promoting curriculum reform and improving the quality of education and teaching. The evaluation criteria for "Golden Courses" mainly revolve around "two natures and one degree", namely high-level nature, innovativeness, and challenge[1]. In November 2018, at the 11th "China University Teaching Forum", the goal of building five types of "Golden Courses" and corresponding reference standards were proposed, including offline "Golden Courses", online "Golden Courses", blended (online and offline) "Golden Courses", virtual simulation "Golden Courses", and social practice "Golden Courses" [9,10]. The construction of "Golden Courses" encompasses both physical spaces and virtual spaces; it involves not only formal course teaching but also extracurricular social practice activities[2]. In October 2019, the Ministry of Education issued the "Implementation Opinions on the Construction of First-Class Undergraduate Courses", proposing to establish around 10,000 national-level and 10,000 provincial-level first-class undergraduate courses between 2019 and 2021[3]. In November 2020, the Ministry of Education selected 5,118 national-level first-class undergraduate "Golden Courses" for the first time, and in

June 2023, it selected the second batch of 5,750 national-level first-class undergraduate "Golden Courses" [11-14].

Over the years, universities have made significant progress and accumulated rich experience in the practice of creating "Golden Courses." [15,16] Based on the standards for "Golden Courses" construction, this study has developed an outcome-oriented, project-driven blended teaching mode in the context of a smart teaching environment for computer programming practice courses [17-20]. A series of educational and teaching reforms have been implemented, aiming to enhance students' high-order thinking skills, problem-solving abilities, and innovative practical capabilities, in order to cultivate computer professionals who meet the demands of the times for society.

1 Analysis of Problems in Blended Teaching of Computer Programming Practice Courses

Computer programming practice courses encompass various categories such as fundamental programming languages, algorithms and data structures, database applications, software development, artificial intelligence, and machine learning. These courses focus on applying theoretical knowledge to solve practical problems, emphasizing hands-on practice, exploration, and innovation. However, due to the complex knowledge system, rapid technological updates, and high industry demands, these courses often pose significant challenges for both teaching and learning, resulting in less than ideal educational outcomes. Many university teachers have realized in recent years that there are various problems in the teaching process, including students' weak professional understanding and unclear learning objectives; disconnection between theoretical coursework and practical application, outdated knowledge and skills; outdated course teaching objectives, insufficient practical innovation; mostly one-way teaching in classrooms, and low student engagement; single evaluation criteria for assessment results, and students' cramming for exams. To address these issues and improve teaching effectiveness, numerous teachers of computer programming practice courses have not only continuously updated the course content system but also developed online resources and adopted blended teaching methods for educational reform. Based on their own teaching styles and course characteristics, they have constructed different blended teaching modes, which have to some extent enhanced students' enthusiasm, strengthened their practical skills, problem-solving abilities, and autonomous learning capabilities. At the same time, this approach has also provided more possibilities for diversified teaching evaluations. However, while the blended teaching reform of computer practice courses has achieved certain successes in practice, it also faces the following problems and challenges.

1）The integration of ideological and political education is not effective enough, and the operability of course objectives is not strong

Some computer programming practice courses, while focusing on improving students' professional skills, neglect education in moral qualities, social responsibilities, and ethical considerations in technology. For instance, they overlook the importance of code readability, maintainability, respect for others' intellectual property rights, as well as guidance on information security and privacy protection in programming instruction. As a result, it is difficult to cultivate composite computer professionals who possess both professional skills and high moral character. Some computer programming practice courses have overly broad or abstract objectives, or their objectives are vaguely stated, lack measurable standards, or differ from the practical teaching content of the course. This results in students being unable to clearly understand and achieve the objectives, and teachers also find it difficult to accurately assess students' learning outcomes.

2）The quality of teaching resources is not high, and the integration between online and offline resources is low

Some computer programming practice courses fail to fully consider the role of online resources in the overall teaching process. Coupled with an inadequate review mechanism for online teaching resources, there is often a lack of high-quality instructional design for information technology. This results in phenomena such as simple copy-and-paste of traditional textbooks, failure to keep up with cutting-edge developments, and monotonous presentation forms. Given the rapid pace of technological updates and iterations in the computer industry, if online resources lack novelty, depth, and breadth, they will not be challenging for students. This not only affects the effectiveness of autonomous learning but also prevents personalized learning and may even reduce students' acceptance of online learning, let alone fostering innovation. Additionally, some computer programming practice courses neglect the development of classroom teaching resources, resulting in a low degree of integration between online and offline resources. This makes it impossible to achieve knowledge internalization, and there is no way to talk about practical engineering capabilities in computer project development.

3）The design of hybrid teaching lacks direction, and online and offline teaching cannot be deeply integrated

Some partially blended teaching designs lack directionality, either still focusing on the transmission of course knowledge rather than being outcome-oriented, or simply moving the traditional lecture model to an online environment where students independently complete programming practical tasks with reference to online resources. Alternatively, they may not fully consider the characteristics of computer practical courses and students' existing abilities, instead copying hybrid teaching models that emphasize theoretical courses. Additionally, they may fail to compactly arrange learning content and activities according to students' individual needs and learning styles. Meanwhile, teachers' guidance and supervision are inadequate, and students' ability to engage in blended learning is limited, resulting in low concentration during autonomous learning. Some students need to invest excessive time before and after class to complete the assigned tasks, leading to inefficiency and impacting their learning in other courses. These are merely superficial blends of online and offline formats lacking deep integration, causing the teaching effects to deviate from expected settings. As a result, students' knowledge, abilities, and qualities cannot be organically fused, and higher-order goals are difficult to achieve.

4）Student evaluation overly emphasizes superficial indicators and fails to comprehensively reflect students' learning outcomes

The use of online platforms indeed brings convenience to the tracking and evaluation of students' learning processes. However, some courses lack effective teaching scenario creation, scientific teaching management, and multidimensional teaching evaluation mechanisms. As a result, evaluation overly focuses on superficial indicators such as online learning duration, attendance records, video watching time, the number of discussion completions, and unit test scores. There is a lack of channels for collecting data on students' ability to solve problems using acquired knowledge and their project development skills, which are essential for evaluating computer programming practice courses. Merely analyzing surface indicator data and providing real-time feedback holds no substantive significance and fails to comprehensively reflect students' learning outcomes.

2 Clarify the construction requirements for computer programming practice courses around the goal of achieving first-class curriculum standards

Courses are the core element of talent cultivation, and the quality of courses directly determines the quality of talent cultivation. The overall goal of first-class course construction proposed in the "Implementation Opinions of the Ministry of Education on First-Class Undergraduate Course Construction" (Jiao Gao [2019] No. 8) emphasizes the need to establish a new concept of course construction, promote curriculum reform and innovation, implement scientific course evaluation, and enforce strict course management. It also advocates improving the quality-oriented incentive mechanism for course construction to form a diverse and varied teaching content and curriculum system[4]. Based on the reference standards for the construction of "online offline blended gold courses" among the five types of gold courses, combined with the requirements of engineering education certification, the requirements for the construction of gold courses in computer programming practice are shown in Table 1.

Table 1: Requirements for the Construction of Gold Courses in Computer Programming Practice courses

Requirements	Description
The timeliness and practicality of ideological and political education integrated into the curriculum	Computer programming practice courses, while emphasizing the goal of "cultivating people with moral integrity and talent" and fostering innovative talents for the new era, should closely follow the development of the computer industry and technological trends, promptly integrating the latest ideological and political elements into the curriculum teaching. At the same time, students should be guided to experience the power and value of ideological and political knowledge in engineering project practice activities, enhancing their sense of social responsibility, honing their personal willpower, and improving their moral character and technical ethics standards.
The high-level nature and achievability of course objectives	The course objectives are of a high level, where students, through independent exploration and team collaboration, are able to design solutions for specific engineering projects, conduct critical analysis and evaluation, and achieve knowledge integration across courses and disciplines. The course objectives should be clear, specific, progressive, and measurable, emphasizing outcome-oriented learning with explicit evaluation and feedback mechanisms in place. The achievement rate of the course objectives is high.
The diversity and challenge of teaching resources	Ensure that teaching resources are abundant and diverse, with content that is standardized, scientific, accurately and clearly expressed, and presented in various formats both online and offline to meet the diverse learning needs of students. The resources should possess a certain level of challenge and ensure the cutting-edge nature of the content. Additionally, design practical tasks and projects with actual application value to stimulate students' interest in learning, encourage them to explore unknown areas, promote deep learning, and cultivate innovative spirit and engineering project practice abilities.
The innovation and	Centered on student development, introduce corporate engineering cases,

sustainability of teaching design	systematically design challenging project tasks, orient towards outcomes, implement flipped classrooms, skillfully set up situations, and enhance students' abilities to solve problems and develop projects, reflecting the organic integration of "knowledge, ability, and quality". Teacher-AI collaborative intelligent teaching promotes the cultivation of students' innovative thinking abilities. Regularly carry out teaching reflections, iterate and optimize, and improve the systematic teaching design scheme.
The systematicness and dynamism of teaching evaluation	Construct a comprehensive and dynamic evaluation system that revolves around the overarching goal of moral education and talent cultivation. Employ human-machine collaborative multifaceted evaluations to assess students' learning outcomes and capability levels in a holistic manner, achieving a precise portrait of students. Collect students' learning data in real-time and analyze it, providing timely feedback and adjustments, regular analysis and summarization, and continuous improvement and optimization.

3 Establish an innovative teaching team and develop a blended teaching reform model for gold courses in computer programming practice

The cultivation of innovative talents cannot be separated from the guidance of innovative and intelligent teachers[5]. With the widespread application of online teaching platforms and new information technologies such as Virtual Reality (VR) and Augmented Reality (AR) in the field of education, it is difficult for a single teacher to fully grasp these new technologies and effectively integrate them into teaching practice. An innovative teaching team composed of professional course teachers, ideological and political teachers, and industry engineers, combined with Artificial Intelligence (AI) technology, can achieve innovation in teaching concepts, scientific and authentic practical projects, and optimization of teaching processes through brainstorming. In the construction of gold courses for computer programming practice, the course team, based on the requirements of course construction and fully considering factors such as the school's educational philosophy and the learning characteristics of the course and students, has carried out a blended teaching reform under the gold course perspective. The course team have established an outcome-oriented, project-driven blended gold course teaching model, and the main process is shown in the figure below.

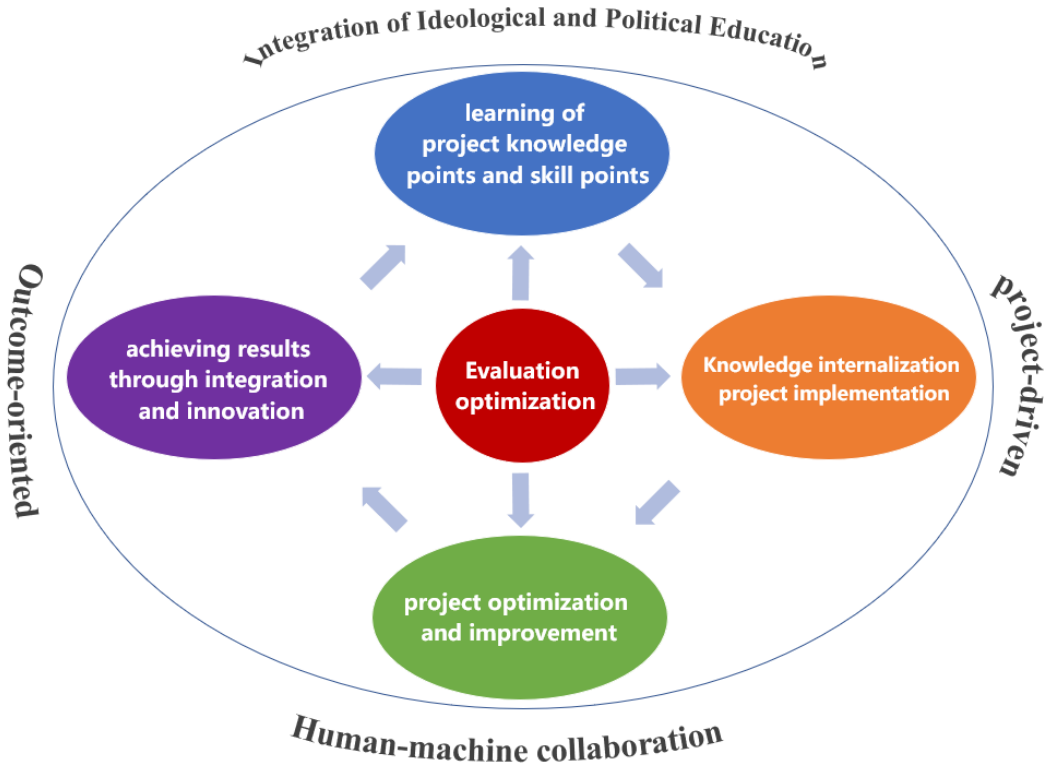

Figure 1 Project-Driven Blended Gold Course Teaching Model

This model, in an intelligent teaching environment, is outcome-oriented and project-based, developing three-dimensional teaching resources. It enters the learning context based on real outcomes and project requirements, collaborates between humans and machines, integrates online and offline, and precisely implements personalized teaching. The aim is to guide students to effectively complete learning tasks at each stage and achieve outcomes at various levels, experiencing a learning process from basic to comprehensive and then to innovation. It aims to facilitate the transformation and enhancement from knowledge and skill acquisition, project realization, optimization and improvement, to integrated innovation, thereby promoting the continuous improvement of students' higher-order thinking skills, problem-solving abilities, and innovative practice capabilities.

4 Benchmark against top-tier core textbooks and develop high-level, challenging, and three-dimensional teaching resources for projects

To promote the reform of the education and teaching system and foster top-notch innovative talents, a pilot work plan for undergraduate education and teaching reform (referred to as the "101 Plan") was launched in the field of computer science in December 2021. The plan focuses on advancing the construction of "four first-class" elements: first-class core courses, first-class core textbooks, first-class teaching teams, and first-class practical projects. The first-class core textbooks are required to "reflect the international academic frontier and possess Chinese characteristics," emphasizing the integration of theory and practice, highlighting case analysis and problem-orientation, and embodying high-level, innovative, and challenging characteristics[6]. The course team, in conjunction with the course objectives and industry applications, sets practical and challenging integrated projects. Based on the project requirements, they reconstruct the knowledge and skill system and develop diverse three-dimensional school-based teaching resources. These resources are rich and varied, primarily including printed textbooks, online course materials, and extended project cases.

Figure 2 Three-dimensional Teaching Materials

The printed textbook includes basic knowledge, skill cases, and comprehensive project cases for the course. In blended learning, the basic knowledge and skill cases provide students with a lasting learning resource that is easy to annotate and mark, serving as the cornerstone for students to understand and master the course content. The comprehensive projects, derived from real-world enterprise cases, offer students a systematic and structured learning path, becoming a major component of deep learning and high-level activities.

Online course resources are designed and developed based on the knowledge points and skill points involved in the projects, including micro-videos of knowledge points, basic task sheets, discussion libraries, test banks, and extended resources. In blended learning, these resources allow students to learn according to their own schedules and learning paces, breaking the time and space constraints of traditional classrooms and meeting the needs of different students. At the same time, the online course platform encourages students to manage their learning process independently, including self-assessment and self-direction, which is conducive to cultivating autonomous learning abilities and lifelong learning skills. Additionally, platform-based discussions, group assignments, and peer reviews enhance effective interaction in the course, promoting communication and collaboration among students.

The extended project cases are derived from newly released engineering projects that have been optimized or innovated by enterprise engineers, posing a certain level of challenge. When collaboratively designing these extended projects, students are required to efficiently manage their learning time and progress, and apply high-order thinking to solve complex project problems. This process helps cultivate students' self-management skills, writing abilities, and sense of responsibility, while also enhancing their innovation capabilities and problem-solving skills.

In blended learning, the three resources of printed textbooks, online courses, and extended project cases are distributed across different time periods and learning stages for students to study. It is essential to fully consider the characteristics of both online and offline learning environments, presenting them in appropriate forms and at suitable times. They should facilitate students' independent online learning while also benefiting teachers' offline guidance and inspiration. At the same time, it is crucial to ensure that the resources are seamlessly connected, providing a coherent learning experience. This way, students' needs for both systematic and personalized learning can be satisfied.

5 Intelligent Environment Empowers with Digital Intelligence, Reshapes Teaching Processes to Build a New Educational Ecology

Although school-based three-dimensional teaching resources encompass both the learning of basic theoretical knowledge and the cultivation of practical skills, as well as the accumulation of industry experience through projects, to provide students with a comprehensive and immersive learning experience, it also requires a smart learning environment, effective blended learning design, and precise learning evaluation. Only in this way can students be challenged and inspired to innovate, and can the achievement of higher-order learning goals become possible throughout the learning process from knowledge acquisition to application, and ultimately to creation.

"China's Education Modernization 2035" emphasizes the need to strengthen the construction of smart campuses, using modern information technology to promote educational reform and innovation, and to enhance the quality and equity of education[7]. Smart campuses provide convenient conditions for teachers' teaching reforms, not only enabling the pre-class delivery of learning resources and in-class guidance and Q&A, but also providing a basis for post-class expansion and enhancement, as well as precise evaluation. The empowerment of digital intelligence provides data support for precise teaching reforms.

In the intelligent teaching environment, the four steps of knowledge and skill acquisition, project implementation, optimization and improvement, and integration and innovation in the outcome-oriented, project-driven blended "golden course" teaching design constitute a cyclical and iterative process in computer programming practice courses, with each step providing the foundation and input for the next. The specific teaching process is as follows:

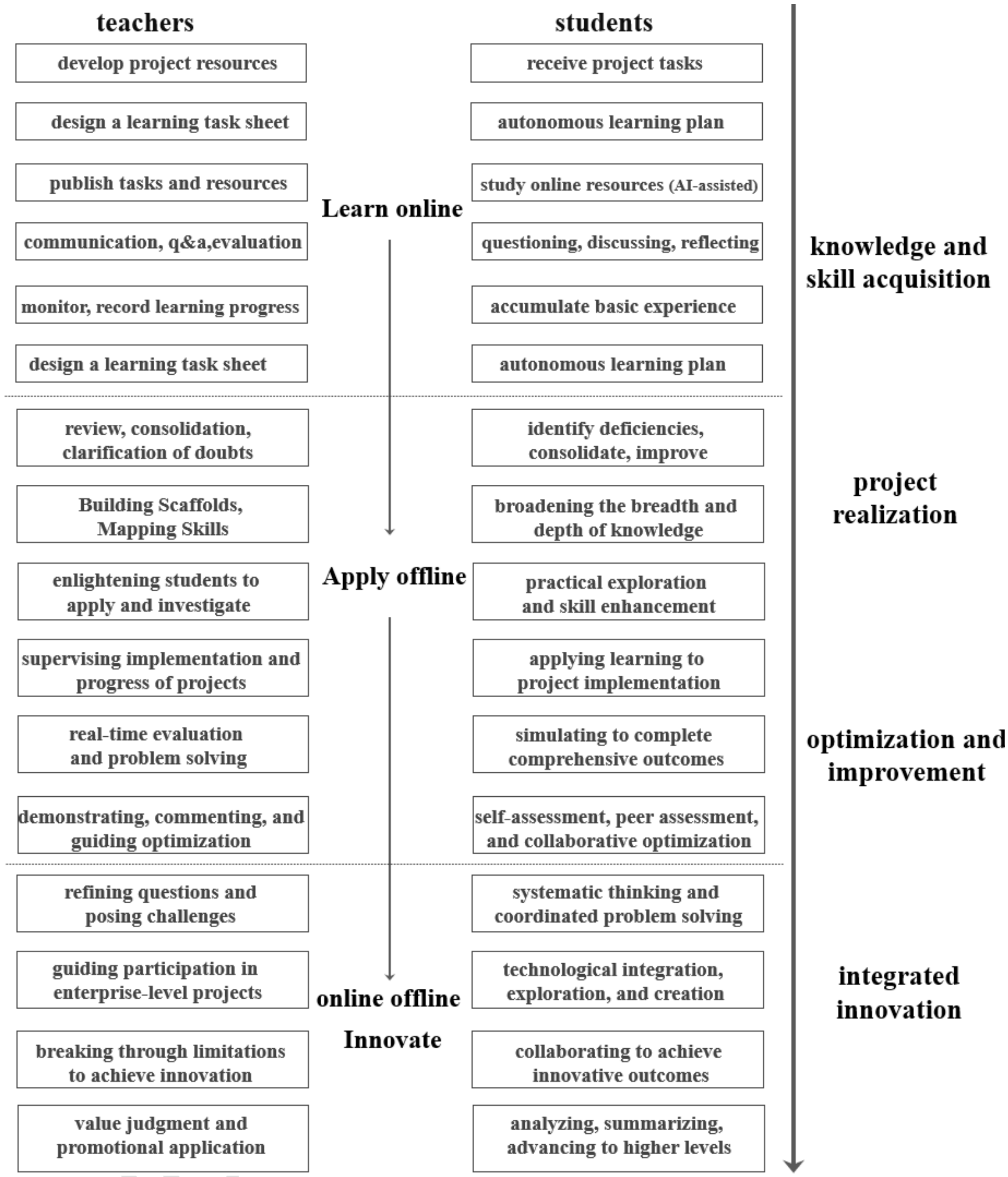

Figure 3 Project-Driven Blended Gold Course Teaching Flowchart

5.1Learn online

1) Teachers prepare and publish online resources and tasks

Teachers integrate three-dimensional teaching resources for computer programming practice courses, clarify project tasks, develop and integrate resources related to the knowledge points required for the project; design learning task sheets to provide students with study ideas, methods, and evaluation criteria, and publish them on the platform to prepare for students' independent online learning.

2) Students engage in independent online learning

Students log in to the online course platform, pick up project tasks, and plan their learning process based on task sheets. They independently study micro-videos, rich-text resources, and complete discussions, quizzes, and basic tasks related to knowledge points, while also recording any difficulties. Difficulties can be discussed with peers, submitted to teachers, or resolved with the help of intelligent assistants. Students can use intelligent technologies, such as asking questions on the official website of artificial intelligence, using chatbots and virtual teaching assistants on the course platform, to solve problems encountered during independent learning of knowledge points in real-time.

3) Teachers supervise and understand students' online learning behaviors

Teachers monitor and understand students' online learning behaviors through the online course platform in real-time. They track the usage of learning resources such as videos or rich-text materials, online duration, and the number of discussions participated in, to gauge students' engagement and commitment to independent study. Additionally, by observing students' pausing and replaying behaviors while watching micro-lesson videos and the issues they feedback in discussions or basic tasks, teachers can identify the difficulties students are facing in their studies. By analyzing students' quiz scores on knowledge points and the details of their discussions, teachers can assess students' mastery of the knowledge, cognitive abilities, and gain a comprehensive understanding of students' learning outcomes, thereby adjusting offline teaching strategies.

4) Students accumulate foundational experience for projects

Students complete programming tasks for micro-lesson knowledge points, applying concepts to solve basic problems. This not only helps to strengthen their understanding of the concepts and solidify foundational knowledge but also enhances their comprehension, programming skills, and depth of thinking, which is crucial for accumulating experience in project development.

5.2 Apply offline

1) Teachers provide answers to doubts, build scaffolding, and inspire inquiry

Teachers use questioning or assessment methods to check students' independent online learning and organize in-depth discussions based on the difficulties identified from students' online learning data. For common issues, they organize discussions and brainstorming sessions based on classic computer programming practice course cases to deepen the understanding and mastery of basic knowledge points. For individual issues, they inspire individual students to analyze and explore, providing personalized support and building scaffolding to facilitate problem-solving.

2) Students identify and fill gaps, internalize knowledge, and apply what they have learned

Students first target their efforts to identify and fill gaps under the guidance of teachers, then proceed to apply and explore based on the scaffolding provided by teachers. When encountering problems, they can also rely on AI in real-time to resolve issues, achieving the internalization of project knowledge points and mapping them to various skill points in the project.

Since computer programming practice courses require continuous, systematic, and effective hands-on practice to ensure the quality of students' learning, teachers must provide ample time for students to engage in effective practical exercises during this phase[8]. At the same time, teachers should carefully observe students' facial expressions and body language to encourage them to actively solve problems encountered during hands-on practice.For simpler practical issues, teachers can guide students to use intelligent assistants to solve problems, or refer to documents created by the teacher that include common issues and solutions, as well as how to use debugging tools and read error messages. For more complex practical issues, students can post questions on a forum or use existing platforms to ask for answers from teachers and other students. Students can also use tools like Visual Studio Code's Live Share or Google Docs to share code, allowing teachers to directly review, evaluate, and provide assistance.By identifying and resolving issues in the code-writing process promptly during the evaluation, students can convert theoretical knowledge into practical skills, thus being well-prepared for project development.

3）Students carry out project implementation, peer review of projects, and optimization and improvement of projects

Students systematically plan the project, determine the individual tasks of team members, and work together to implement them. When encountering problems, the team collaborates to solve them or seeks assistance from teachers. They complete comprehensive projects, achieving a leap from practical operation skills to project development and application capabilities.

Each group presents their comprehensive outcomes, engages in peer review and reflection, and collaborates to refactor code, refine features, enhance security, and improve interactive experiences. They work together to refine and optimize the project's implementation methods and processes.

4）Teachers supervise the progress of project implementation, solve problems, and provide comments and optimization suggestions

Teachers supervise the entire process of student project implementation, providing real-time answers to questions that arise during the project. They also use automated code assessment platforms such as Huawei Cloud Code, SonarQube, Checkstyle, and Tencent Cloud Code to check and analyze whether students' projects adhere to good programming practices. This includes the readability of the code, the sufficiency of comments, naming conventions, and the cleanliness of the code. Teachers evaluate the comprehensive outcomes of the students and provide feedback, guiding them to follow technical ethics standards and adopt best practices and industry-related standards in the computer field to optimize code writing and improve code quality. This approach enhances students' sense of social responsibility and improves their ability to develop code in a standardized and efficient manner in actual work environments.

5.3 Innovate Both Online and Offline

Teachers distill expandable issues from the project implementation process, assign challenging tasks offline to guide students to break through the limitations of courses and majors to explore and create, achieving innovative outcomes. Online, they guide students to participate in enterprise-level projects, which not only helps them understand the workplace culture, workflow, and professional standards of the computer industry but also allows them to gain a deeper understanding of the latest trends and actual needs of the computer industry, providing guidance for their future learning and work. At the same time, they offer timely encouragement when students encounter difficulties in the implementation of enterprise-level projects, honing students' will and enhancing their problem-solving abilities.

Under the guidance of teachers, students engage in systematic thinking, extend their thought processes, coordinate collaboration, and effectively integrate knowledge points or skill points from other courses in the curriculum or other computer science courses, and even from other professional fields, to complete challenging tasks and achieve innovative outcomes. By applying the technologies and concepts related to their innovative results, they work in groups to complete enterprise project tasks, conduct analysis and summaries, achieve higher-level goals, and comprehensively enhance their professional qualities.

When teachers use automated code assessment platforms to evaluate the challenge tasks and enterprise-level projects submitted by students, they should examine the students' ability to analyze and solve problems in the face of programming task challenges, including their understanding and positioning of the challenge tasks, the practicality and innovation of the solutions; they should also assess the students' roles and contributions within the group; evaluate the students' abilities in project planning, time management, and resource coordination; and take into account various aspects such as the sense of social responsibility and technical ethics embedded in the project design.

5.4 Systematic and Dynamic Evaluation

The blended gold course teaching model, which integrates online learning, offline application, and online-offline innovation, encompasses evaluation in every aspect. From knowledge point checks, discussions, and basic tasks in online autonomous learning, to real-time inspections and guidance by teachers during classroom knowledge internalization, to peer evaluations and teacher feedback for optimization during comprehensive project implementation, and finally to comprehensive evaluations in extended projects, this comprehensive, systematic, real-time, and interactive evaluation approach helps to comprehensively and objectively understand students' learning situations and teaching effectiveness. Each evaluation prepares for the next stage of learning tasks and optimizes the teaching process, thereby promoting the continuous improvement of teaching quality.

6 Leverage the advantages of artificial intelligence to achieve human-machine collaboration and continuous teaching optimization

Human-computer collaborative teaching is an important trend and practical direction in the development of education in the era of artificial intelligence, and it is gradually and deeply promoting the innovative development of university teaching[9]. In the implementation process of outcome-oriented, project-driven blended gold courses, course team teachers and machines each perform their own strengths, promote each other, and effectively achieve human-computer collaborative work and continuous optimization of teaching.

Online course platforms with a variety of resource presentation methods create a diverse online learning experience for students. The platform's push notifications for knowledge point checks, unit tests, intelligent grading, and multidimensional analysis, along with the learning behavior data recorded by the platform, help teachers to supervise and promptly understand students' self-directed learning situations. The platform also establishes a free and convenient interactive environment to assist students in conducting online group discussions and collaborative activities.

Intelligent assistant tools provide an immediate communication learning environment that can solve problems encountered during online and offline learning in real-time. This allows students to enjoy an engaging interactive experience while also gaining inspiration and ideas for research, effectively promoting personalized learning and inquiry-based learning.

Automated code assessment platforms are unique teaching aids for computer programming practice courses, ensuring that the comprehensive project outcomes of all students are assessed in a timely manner according to the same coding standards. These platforms not only increase the timeliness, objectivity, and fairness of assessments but also enable students to quickly identify and standardize the correction of errors.

Teachers collaborate with online course platforms, intelligent assistant tools, and automated code systems to supervise and evaluate computer programming practice courses, as well as to answer questions and discuss. This not only expands the time and space for student learning, allowing them to experience more efficient learning support and services; at the same time, it frees teachers from repetitive labor, allowing them to allocate more time and energy to analyze the student learning behavior data collected by platforms and tools, identify prominent issues in teaching, and adjust teaching strategies and optimize teaching plans in real-time. Teachers have more time to pay attention to students' emotional changes, clarify the main issues affecting student cognition, thereby stimulating students' curiosity and desire to explore, encouraging students to undertake challenging and innovative research, collaborating with students to improve focus and achieve higher-order learning.

7 Teaching effectiveness

In the spring semester of 2024, the course team implemented an outcome-oriented, project-driven blended golden course teaching reform for four computer programming practice courses: "Fundamentals of Web Front-end Development", "Algorithms and Data Structures", "Object-Oriented Programming", and "HTML5 Development and Application Technology". Analysis of questionnaire survey results from 123 students in four classes before and after the courses showed that 80.5% of the students believed the course objectives were of high quality, 62.6% felt the objectives were achievable, 55.3% found the course content to be somewhat challenging, 72.4% thought the teaching reform model implemented by the teachers was somewhat innovative, and 63.4% believed the reform model was suitable for them. Additionally, 82.9% of the students improved in their autonomous learning ability, 71.5% in their learning methods, 57.7% in their knowledge application skills, 61.8% in their problem-solving and inquiry skills, and 51.2% in their engineering project practice and innovation abilities. The percentage of students who were very interested in the courses increased from 39.8% before the courses to 88.6% after. Regarding their expectations for their final course grades, 47.2% of the students showed significant improvement, and 45.5% showed some improvement. The percentage of students willing to pursue careers related to their major increased from 45.5% before the courses to 80.4% after.

In summary, the outcome-oriented, project-driven blended gold course teaching reform has enabled students to achieve a transformation and enhancement from knowledge and skill acquisition, project implementation, optimization and improvement, to integration and innovation, reflecting the gold course standards of advanced nature, innovation, and challenge.

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