Construction and Practice of the Dual-line Integrated Smart Teaching Model

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Abstract. With the development of information technology and innovation in education, the traditional face-to-face teaching model has been unable to meet the diverse needs, while online education is also facing the challenges of interaction and humanistic care. Therefore, in order to provide students with a more comprehensive and personalized learning experience, the online and offline integrated teaching model comes into being.
To enhance the classroom teaching effect of dual-line(online & offline) integration, we utilized the "rain classroom" during pre-class、in-class and post-class activities. At the same time, we also adopted the process assessment based on "knowledge + ability + quality" fusion, providing students with a platform for self-examination and autonomous learning, and eventually formed a quality traceable closed-loop curriculum evaluation system. This model can effectively improve and stimulate students' intrinsic motivation to learn, and cultivate students' critical thinking and innovative thinking abilities.

Keywords: Intelligent tools; dual-line integration; process assessment; innovation ability; self- learning

1 Introduction

With the rapid development of information technology and continuous innovation in education, the traditional face-to-face teaching model has been unable to meet the diversified needs of education in today's society. However, although online education brings convenience, it also faces the problem of lack of interaction and humanistic care. In this context, the online and offline dual integrated classroom model has come into being, bringing new opportunities for development in the field of education.

This classroom model can provide students with a more comprehensive and personalized learning experience. Through online learning, students can access rich learning resources at anytime and anywhere, and arrange their own learning progress to improve their independent learning ability. Through offline learning, students can get personalized guidance from teachers, communicate and cooperate with classmates face to face, and so enhance their interpersonal skills.

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In addition, this model can effectively improve the quality and effectiveness of teaching. Teachers can adjust teaching strategies according to the students' learning situation in time to achieve accurate teaching. Students can evaluate their own learning status through online tests to check and fill gaps in time. The interactive situations created by this model can help cultivate students' critical thinking and innovative thinking skills.

The difficulties faced by the traditional teaching mode mainly include the following aspects:

(1) Lack of individuation[1]:The traditional teaching mode typically employs a "one-size-fits-all" approach, making it challenging to cater to the diverse learning needs and interests of individual students. Consequently, teachers often struggle to personalize their teaching methods to accommodate the unique differences among students, leading to some students being unable to fully realize their potential.

(2) Lack of interaction and low enthusiasm of students: In traditional teaching mode, teachers are often one-way transmitters of knowledge, and students passively accept knowledge. Classroom interaction is less, students lack the opportunity to think and question, which limits students' thinking ability and creativity.

(3) Insufficient cultivation of innovative ability: Traditional teaching mode often focuses on the indoctrination of knowledge and the training of test-taking skills, but neglects the cultivation of the students' innovative ability and critical thinking. As a result, students lack the ability to think independently and solve problems when facing new problems.

(4) It is difficult to cope with the era of information explosion: with the rapid development of information technology, the speed of knowledge update is accelerated, and the traditional teaching mode is difficult to keep up with the pace of The Times. Teachers may face problems such as the lagging content of textbooks and outdated teaching methods, which will affect the teaching effect.

The dual-line integrated teaching mode supported by smart tools has laid a solid foundation for the development of a high-quality classroom ecology. In addition, the whole process of online teaching has given the two-line integrated teaching a new opportunity to deepen the development of smart classroom, and promoted the application of smart classroom in the teaching field.

2 Curriculum Practice of dual-line integrated wisdom teaching mode(taking c language as an example)

(1) Combing the course teaching objectives according to the requirements of engineering certification.

Adhering to the flip teaching concept of "competition motivation, independent learning, ability improvement and student development", combined with the engineering practical ability and innovation requirements of engineering education certification for soft engineering majors, the teaching objectives of this course are: reform the teaching content, teaching means and methods, improve students' comprehensive knowledge reserve, and cultivate students' comprehensive ability to solve complex problems; Integrate the cultivation of ideological and political elements, and advocate students to be trustworthy, confident, self-discipline and

self-improvement; Create a problem-driven, task-led, reflecting practical ability and critical thinking ability to cultivate the charm of the classroom, stimulate students' learning initiative, in order to achieve "teach people to fish", "teaching win-win" classroom teaching effect[2]. The course objectives of this course are shown in Figure 1.

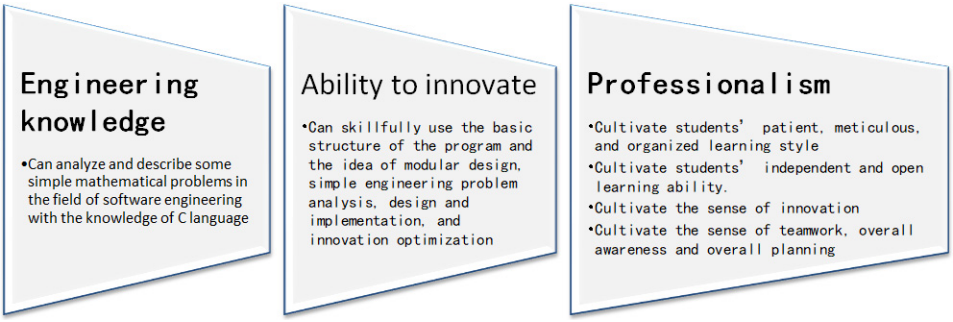

Figure 1 Course objectives

(2) Construct learning resource base with ability cultivation as the main line

1) In order to achieve the curriculum objectives and improve students' problem-solving engineering practice ability and innovative thinking ability, we design interesting teaching case database ((as shown in Figure 4) by relying on intelligent tool platforms such as Rain Classroom (as shown in Figure 2) and ACM-OJ ((as shown in Figure 3).

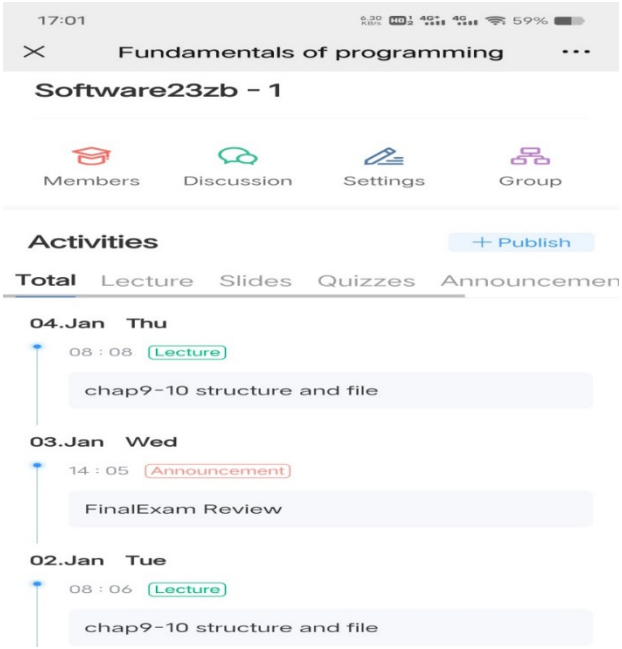

Figure 2 Rain Classroom resources

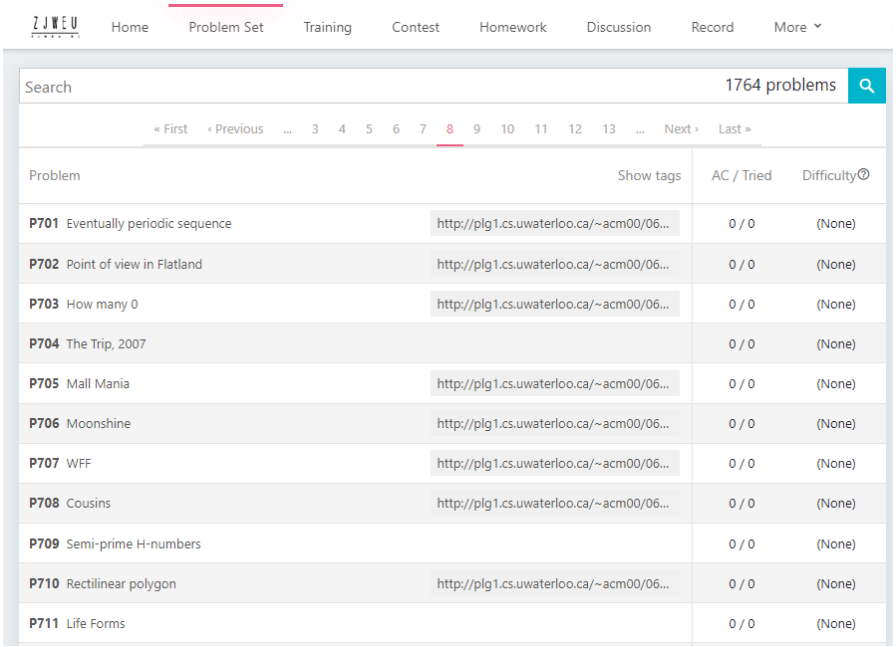

Figure3 Zjweu-OJ

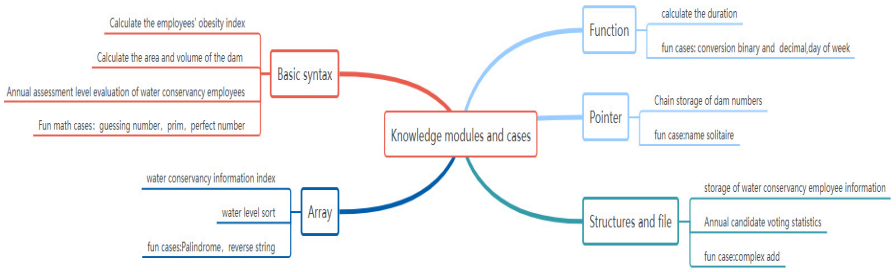

Figure 4 Teaching contents and cases

2) Dig deep into the ideological and political education materials contained in the content of professional knowledge, and integrate the ideological and political elements of the software industry such as coding norms, professional ethics, and craftsman spirit into the class, combining with the reality of students, and imperceptibly shaping students' correct outlook on life and values. The specific implementation path can be summarized as "integration and establishment". The so-called "integration" means that the curriculum standard remains unchanged, through in-depth analysis of the teaching content, to find the right ideological and political mapping points and entry points, the ideological and political elements are quietly integrated into the whole teaching process, to achieve the integration of knowledge imparting and value leading, teaching and educating people. The so-called "standing" refers to moral tree people, moral first, tree people as the basis, physical practice to set an example, set an example to lead the correct outlook on life and values[2][3].

Through the re-integration and design of the teaching content, the ideological and political elements are cleverly integrated into it (as shown in Table 1), so that student scan accept them imperceptibly in the process of listening to the lesson, and achieve the teaching effect of touching things quietly.

Table 1 Ideological and political elements of the course

Serial Number	Knowledge Points	Ideological and political integration
1	Routine	Introduce IT industry background and corporate figures, guide students to learn more from outstanding predecessors, follow professional ethics, and advocate standardized coding and craftsman spirit
2	Algorithms	Guide students to do things according to procedures and rules, and follow the logic of things themselves
3	Choosing structure	Guide students at the crossroads of life choices, how to make the right choice
4	Loop structure	Guide students to persevere when they encounter difficulties and have the spirit of an indomitable craftsman
5	Array	That is, categorize ideas and guide students to associate with positive people with positive energy
6	Functions	Divide and rule, guide students in daily affairs how to division of labor, teamwork
7	Pointers	Flexible, but do not leave its roots, guide students not to forget the original heart, abide by professional ethics

(3) Construct a two-line integrated teaching mode based on intelligent tools such as rain class

Adhering to the "flip" concept of "competition motivation, independent learning and ability improvement", carrying out the classroom mode based on intelligent tools such as rain classroom can effectively realize the seamless connection of the three stages before class, during class and after class, provide time and space for learners' independent and personalized learning through pre-class teaching design, and improve the quality of classroom teaching through deep learning activity design during class. Through relevant reflection learning after class, it can promote the construction and internalization of students' knowledge concepts, and realize equal emphasis on pre-class, during class and after class, so as to improve the effectiveness of education. Figure5 shows the two-line integrated wisdom teaching mode[3][4] based on the rain class.

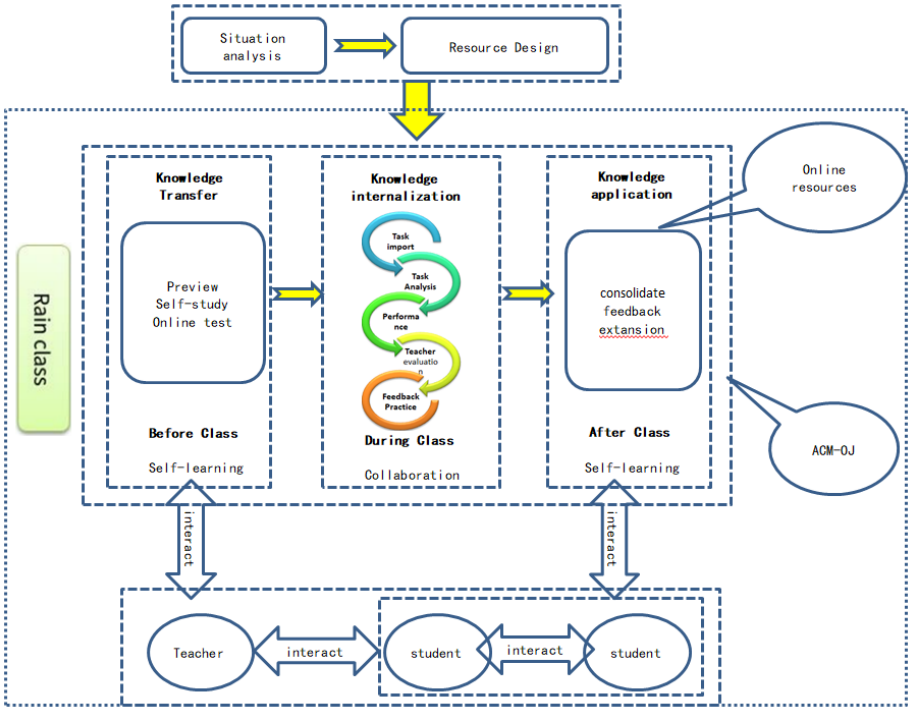

Figure 5 Two-line fusion mode based on rain classroom

Before class: Learning situation analysis is the starting point and core of smart classroom teaching design. It is necessary to break the original classroom boundaries, achieve low-level cognitive goals, and appropriately return them to students according to the characteristics of students' psychological stages. OTO classroom teaching should be designed to solve problems and deepen learning experience with teacher-student interaction and student-student interaction.

a. Set up a learning team based on the ACM competition system and carry out classroom teamwork cooperative learning

Adhering to the principle of "happy programming, strong and weak matching, intra group cooperation, and inter group competition", we form an ACM learning team in groups of 2-3 people (using Rain Classroom grouping) to work together to complete each classroom learning task and experimental practice task. This not only stimulates the learning enthusiasm and participation of students with weaker learning abilities, but also enhances their teamwork spirit and improves the overall engineering practice level of problem-solving in the team.

b. Prepare online and offline resources and make courseware.

During the process of using "Rain Classroom" for lesson preparation, teachers can directly introduce Mooc teaching videos from well-known universities for pre class preview; Can create preview tests to test students' preview situation through limited time answering; Can design diverse classroom interactive elements, and conduct classroom interaction and

discussion through bullet comments or submission methods; To enhance their level of collaboration and problem-solving skills in engineering practice, teachers can also create practical classroom tasks or self-study tasks, allowing students to complete them in a team manner through random roll call.

In class: Adopting the concept of OBE, with the goal of enhancing students' innovative thinking, we introduce intelligent tools such as Rain Classroom, such as bullet comments, submissions, discussions, and group practice, to achieve deep learning.

Students first enter the classroom by scanning the classroom code released by the teacher. In addition, by releasing pre designed pre class preview checks and using timed quizzes, they can check their preview situation, facilitate personalized and targeted teaching, and combine the number of students in the classroom code with the number of answering questions to correctly control their attendance.

In the classroom, the team interactive and collaborative teaching mode of "task introduction task analysis group practice teacher feedback, group mutual evaluation feedback practice" is adopted (as shown in Figure 6) to analyze the key points of implementing the import task, clarify the knowledge and skill points involved in completing this task, and focus on exploring and analyzing the key and difficult points of the problem. This approach not only enhances the atmosphere of the "school", but also enhances students' teamwork awareness, critical thinking ability, and problem-solving engineering practice ability.

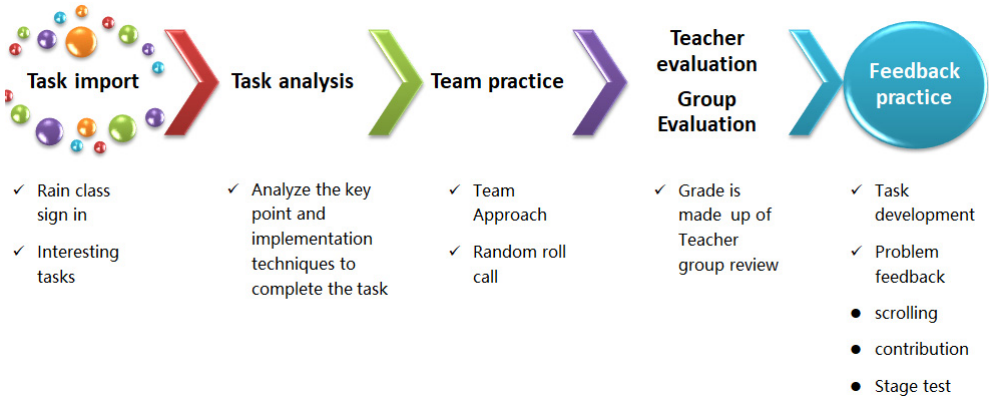

Figure 6 5-STEPS teaching mode

After a learning unit is completed, the Rain Classroom will be used to conduct online stage tests (as shown in Figure 7) to test students' mastery of this knowledge unit.

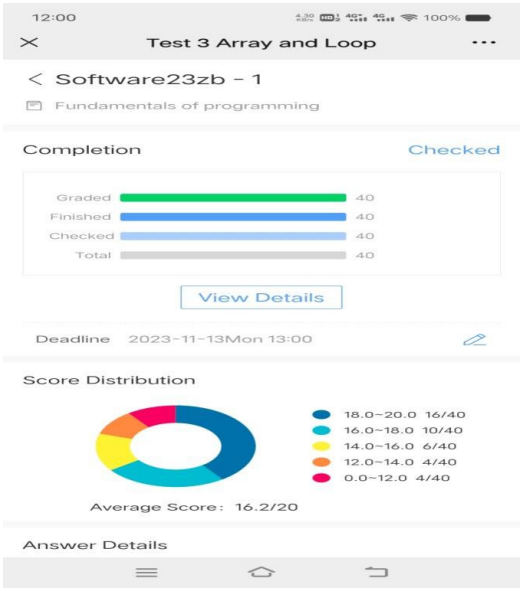

Figure 7 test

After class: By reviewing the course summary section of Rain Classroom (as shown in Figure 8), teachers can timely grasp the overall learning situation of students and assign targeted extracurricular tasks (as shown in Figure 9), allowing students to conduct self-examination and improvement. In addition, students are also encouraged to use open online resources (such as Mooc and ACM-OJ platforms) for active learning and consolidation outside of class. Combining student portraits, conducting scientific planning, focusing on cultivating students' self-learning abilities, and helping them further develop.

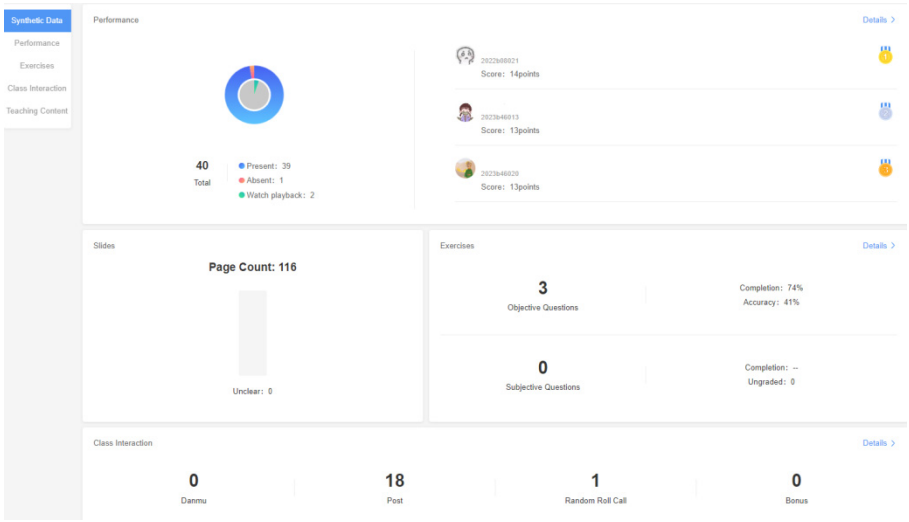

Figure 8 Course Summary

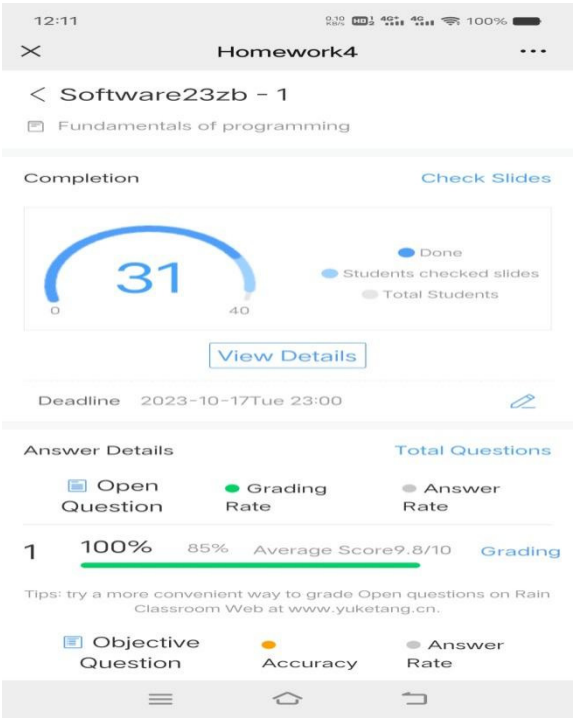

Figure 9 homework

(4) Practice the process assessment of "knowledge+ ability+ quality " integration

The assessment method adopts the integration of "knowledge+ ability+ quality" (as shown in Table 2), and the quality performance mainly assesses classroom attendance, classroom participation, including group discussions, classroom questioning, in class practice, and the completion of homework in Rain Classroom. The performance of practical ability mainly tests students' ability to apply each learning module, including code writing ability, program debugging ability, and innovative thinking ability. The performance of knowledge application mainly tests students' comprehensive understanding and application of knowledge.

This assessment model advocates for students to master more knowledge and skills with a persistent learning attitude, emphasizing the assessment of their enthusiasm, participation, and collaboration in the learning process[5][6][7]. The implementation process is shown in Table 3-6.

Table 2 Course assessment rules

Evaluation item		Evaluation Method	Proportion
Quality Performance	Set up a study team, 2 to 3 people in a group, the group's overall performance affects the learning attitude score.		20%
	Attendance	Use rain class sign in each class, attendance:100 points, leave: 50 points, late: 80 points, absenteeism: 0 points, with 20% of the proportion into the usual score	

	Class	Comprehensive evaluation based on class room interaction (bullet screen, submission, test)and pre-class preview test	
	Homework	Based on the completion of homework after class for each knowledge module.	
	Test	According to the module, the stage test is carried out irregularly in the class to test the students' mastery of the knowledge of the module at this stage.	
Ability Performance	Pay attention to the examination of students' understanding and mastery of each learning unit, and pay attention to the cultivation of practical ability		15%
Knowledge performance	Middle Exam	The test will be conducted in the rain class and will mainly consider the learning of the first half of the semester	10%
	Final Exam	Assess the students' comprehensive application ability of C knowledge	55%

Table 3 Class Performance

NO	9.19	9.25	9.26	10.10	10.12	10.16	10.17-23	10.24	10.30	10.31	11.6-8	11.14	11.21-23-27	11.28-12.5	12.11	12.18	12.25	Class
1	0	10	8	6	6	10	14	6	10	14	7	10	3	11	2	4	3	100
2	0	8	5	9	9	10	17	6	7	4	9	13	3	11	1	4	0	100
3	0	10	5	6	6	10	13	6	6	2	13	9	0	0	0	2	2	90
4	0	10	5	6	6	10	19	6	6	2	13	11	0	2	1	4	3	100
5	0	7	5	6	6	10	16	6	7	4	13	12	3	9	3	4	3	100
6	6	11	0	4	10	7	12	0	4	6	4	6	6	7	1	4	2	90
7	6	0	0	5	7	7	12	12	4	4	5	2	4	5	2	4	2	81
8	6	17	5	4	12	9	12	13	6	14	0	4	10	8	3	4	0	100
9	6	11	5	2	10	7	12	6	2	10	5	0	2	14	1	4	2	99

Note: Classroom performance: sum of each class performance, capped at 100

Table 4 Homeword Performance

NO	Homework1-15	Homework2-15	Homework 3-20	Homework 4-20	Homework5-15	Homework6-15	Home work
1	15	15	20	16	11	15	92
2	15	15	14	18	13	10	85
3	11.2	13	16	16	7	8.8	72
4	14.5	15	20	14	13	10	86.5
5	15	15	18	0	11	15	74
6	13	14	16	14	9	13	79
7	11	15	16	12	11	15	80
8	13	15	20	14	8	13	83
9	8	14	14	14	13	15	78

Note: Homework performance: sum of each homework

Table 5 Test Performance

NO	Test1-20	Test2-20	Test3-20	Test4-20	Test5-20	Test
1	17	20	17	18	18	90
2	17	15	19	19	18	88
3	14	15	0	10	14	53
4	13	13	17	15	11	69
5	18	14	17	16	18	83
6	12	14	16	20	16	78
7	0	15	18	20	15	68
8	18	12	16	20	16	82
9	11	15	15	17	10	68

Note: Homework performance: sum of each test

Table 6 Total Permance

NO	Attendance	Class	Homework	Test	Quality Performance	Practice 1	Practice 2	Practice 3	Practice 4	Ability Performance	Middle exam	Final exam	Total
1	100	100	92	90	96.4	90	94	93	91	92	91	81	87
2	100	100	85	88	94.6	92	94.5	95	92	93.4	97	93	94
3	100	90	72	53	81	89	92	92	89	90.5	82	70	76
4	100	100	86.5	69	91.1	91	92	89	93	91.3	88	81	85
5	100	100	74	83	91.4	90	92	92.5	93	91.9	79	87	88
6	95.5	90	79	78	86.5	91	91.5	91	93.5	91.8	94	90	90
7	100	81	80	68	82	93	92	92	91	92	97	83	86
8	97.7	100	83	82	92.5	92	91	91	92	91.5	97	79.7	86
9	100	99	78	68	88.8	93	93	91	92.5	92.4	85	70.5	79

Note：total=Quality performance*0.2+Practice performance*0.15+Middle exam*0.1+Final exam*0.55, Quality performance=Attendance*0.2+Classroom*0.4+Homework*0.2+Test*0.2, Ability performance: sum of each practice

3 Teaching effect

The advantages of the dual line integrated teaching model are:

(1) It can effectively stimulate the internal drive and innovative spirit of students in learning. Not only does it focus on the breadth of the knowledge system, carefully sorting out course content, integrating ideological and political elements such as professional ethics, but it also emphasizes the cultivation of engineering practice ability, value shaping, and professional quality, especially emphasizing the cultivation of the necessary scientific exploration spirit, good professional ethics, and strong social responsibility for future software engineers.

(2) Introducing smart teaching platforms such as Rain Classroom into the classroom has achieved a seamless integration of pre class, in class, and post class teaching mode based on the "flipping" concept. In the classroom, teaching methods such as task guidance, problem driven, case demonstration, and group practice based on interdisciplinary thinking integration are adopted, combining theory and practice to improve the effectiveness of classroom teaching.

(3) By utilizing the ACM-OJ platform, Zhuke Cloud Smart Education Cloud platform, and Rain Classroom Teaching platform, a process assessment integrating "knowledge+ability+quality" is implemented to provide students with a platform for self inspection and self-directed learning outside of class, facilitating the correct control of student learning dynamics and forming a closed-loop curriculum evaluation system with traceable

quality and continuously improving teaching methods and means.

After the first round of teaching attempts, a comparative analysis was conducted on the students' grades. Compared to before implementation, there was a significant improvement in grades (as shown in Figure 10), which effectively stimulated their internal drive and initiative. From the questionnaire survey, it can be seen that most students strongly agree with this model (as shown in Figure 11).

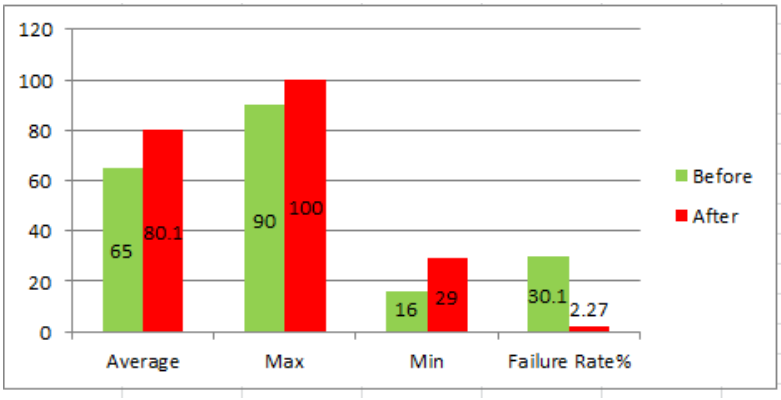

Figure 10 Comparison before and after implementation

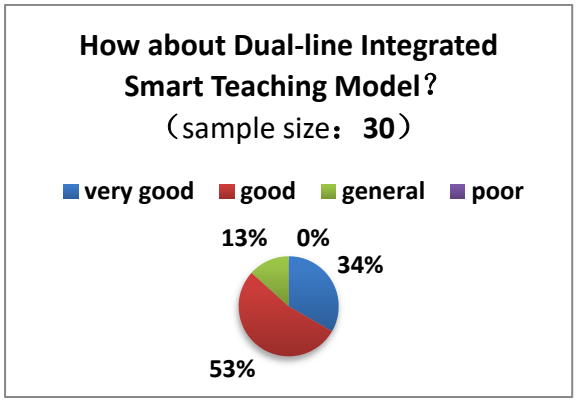

Figure 11 Learning effectiveness questionnaire

After several years of teaching implementation and precipitation, "Basis of Programming" has been rated as "Internet + Teaching" demonstration classroom in Zhejiang Province in 2019 and Zhejiang First-class course in 2020 respectively.

4 Conclusion

This article mainly discusses the practice of the Dual-line Integrated Smart Teaching Model in C language course. Introducing this teaching model into program courses not only provides students with a more comprehensive and personalized learning experience, but also achieves

seamless integration before, during and after class, and improves the classroom teaching effect. At the same time, the model implements the "knowledge + ability + quality" three-integration process assessment, providing students with a platform for self-examination and independent learning, stimulating students' internal drive for learning, and cultivating students' critical thinking ability and innovative thinking ability to solve problems.

Acknowledgments. Key Course of the School in 2023: Basic Programming(ZDKC202383), and Object-Oriented Programming(ZDKC202388)

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