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Practice and Thinking of Blending Learning Based on the "Outcomes-Based Education" Concept
Taking "Computer Programming" Course as an Example

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ABSTRACT
Combining the philosophy of results-oriented "Outcomes-based Education" (OBE) and blending learning mode, this paper takes the "Computer Programming" course as an example to carry out the whole process of "3+3" blending learning practice in pilot class with the purpose of analyzing on academic conditions, students' behavior and teaching effect. The SPSS20.0 is used to perform a paired sample T test on the performance of the pilot class and the control class before and after the intervention. The results show that the consistency of the performance before the intervention is good, and there is a significant difference in the performance after the intervention. So the teaching practice plan is verified to be feasible and effective. Blending learning further promotes the in-depth integration of international technology, education and teaching, which speeds up the construction of "Golden Class" effectively.

Keywords: *Outcomes-based Education, blending learning, Computer Programming, Golden Class*

I. INTRODUCTION

With the rapid development of information technology, three major strategies, "the Belt and Road", "Made in China 2025" and "Internet+" have put forward new requirements and new challenges for the cultivation of applied talents in universities [1]. In this context, it is imperative to explore and research the application-oriented personnel training model that can adapt to the "new engineering" background.

"Computer Programming" is a compulsory general course aimed at cultivating students' innovative application ability. In the first-line teaching practice, the author found that the course is mainly based on the teacher's unidirectional transmission teaching mode. Most students are attracted by the prospect of computer application and interested in the curriculum, but they will gradually become indifferent or intimidating with the boring and passive learning. So this paper builds on the "Super Star Learning Pass" as the platform and adopts "3+3" blending learning mode to text the OBE education concept and the effect of blending learning in this course, which explore the new ideas of wisdom teaching in computer programming courses as well.

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II. RESEARCH BACKGROUND

A. OBE education concept

OBE(Outcomes-Based Education) is called ability-oriented education or goal-oriented education. It was first proposed by American educationist Spady and others in 1981 and it has become the main concept of education reform in Europe and United States. OBE education focus on the final learning achievements of students. This concept is becoming the guiding theory for the cultivation of talents in Chinese universities [2].

B. Blending learning

Blending learning is a teaching practice which combines the advantages of online teaching and traditional teaching. blending learning is student-centered. After more than 20 years of development, domestic and foreign researchers have basically reached a consensus: blending learning will become the "new normalcy" of future education [3]. At present, many domestic universities adopt blending learning as an important measure of teaching reform [4].

III. RESEARCH CONTENT

A. Clearing teaching methods

Through extensive investigation and comparison of many teaching platforms, the author found that "Super Star Learning Pass" has the advantages of massive resources, data synchronization, and rich tools [5]. Therefore, this "leverage" is used to leverage the ability training of students and determine the hybrid teaching method of using mobile learning plus interactive classroom and information technology integration teaching activities.

B. Building online course repository

Online course resources are the basis for the implementation of blending learning. Course resources should be diversified and stereoscopic, when it emphasize the contents and major required [6]. According to the index points required for major graduation and the supporting relationship between the teaching objectives of this course and this lesson(take the Do loop statement as an example, as shown in "Table I"), a systematic method is used to re-construct the instructional design, "Line up the points into lines, connect the lines into a plane". In this way, the difficult knowledge points would be performed by vivid audios and videos which are made by Office 2019 and Camtasia 9.0. Online course resources include teaching materials, teaching micro video, courseware, experiment library, exercise library, homework library and so on.

TABLE I. THE RELATION BETWEEN TALENT TRAINING GOALS AND COURSE TEACHING OBJECTIVES

Graduation requirements	Index point	Support degree	The teaching goal of the course supporting the index point	Support degree	The teaching goal of the course supporting the index point
Knowledge	3.1.1 Mastering the basic theory and basic knowledge of relevant basic disciplines necessary for pharmacy such as Mathematics, Physics, Chemistry, Biology, and basic medicine.	L	Mastering the basic content and the basic methods of VB language and skills of programming.	L	1.Describing the function, characteristics and execution flow of the 4 kinds of statements in the Do loop; 2.Understanding the applicable scenarios of Do loop statements.
Ability	3.2.3 Mastering computer application ability, being able to master the basic methods of document retrieval, data query and the use of modern information technology to obtain relevant information.	H	Having a good ability of information acquisition , mastering the latest programming methods and skills through information retrieval and literature reading.	M	The ability to distinguish between Do loop and For loop statements.
	3.2.4 Having a certain sense of innovation, preliminary scientific research and practical work ability, and the ability to comprehensively apply theoretical knowledge to solve practical problems.	H	Cultivating students' thinking methods and basic abilities in using computers to solve and deal with practical problems.	H	Write code and debug code flexibly for innovative design.
Quality	3.3.3 Having team awareness and dedication, being able to assume the roles of individuals, team members and responsible persons in a team, and being able to communicate in a cross-cultural context under a cross-cultural background.	M	Improving the awareness and ability of teamwork through cooperative division of labor.	H	1. Building a learning community; 2. Exercising the will, cultivating a rigorous scientific attitude and a sound personality; 3. Enjoying the fun of programming and cherish the lofty ideals that help with China's software industry.

C. Designing teaching link

The teaching link includes three stages, namely before, during and after the class. They respectively achieving the three ability-oriented goals of basic learning, advanced learning and innovative application, that is organizing the teaching content according to the "3 + 3" mode, designing the teaching activities of the integration of explaining, learning and practice, as shown in “Fig. 1”.

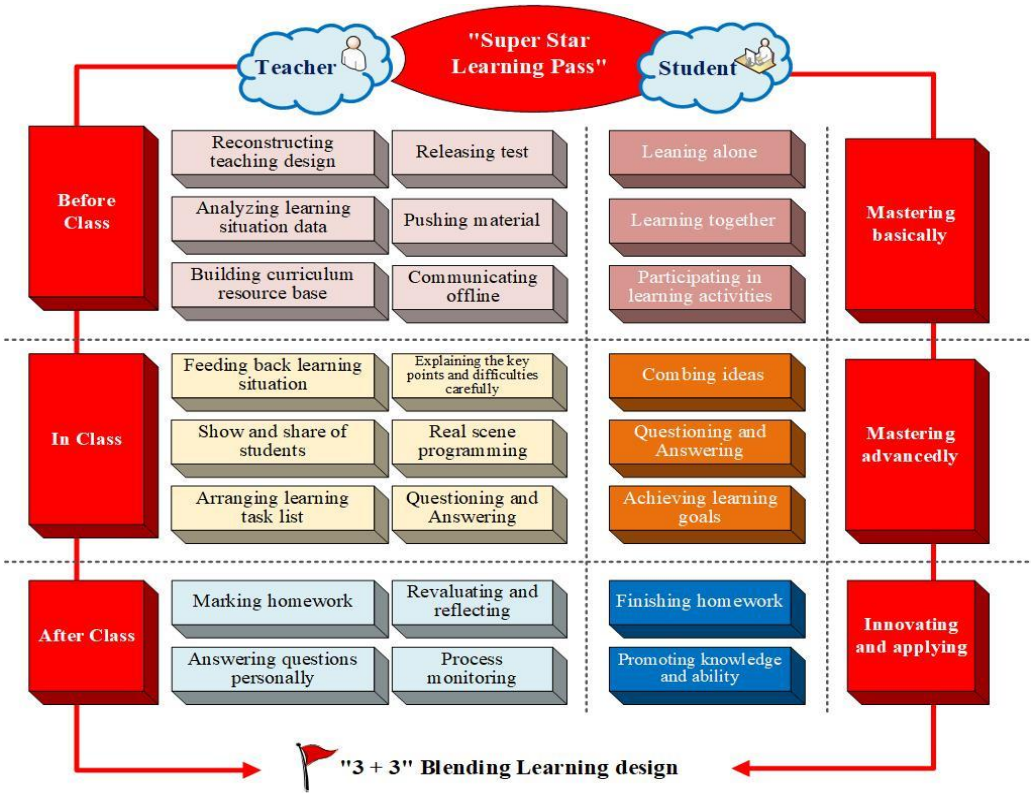

Fig. 1. "3 + 3" blending learning design.

- Before the class, with the help of the powerful storage and dissemination function of the "Super Star Learning Pass", we upload orderly and clearly arranged teaching videos, learning task lists, courseware, assignments, quizzes, and extended literature to the online teaching platform. Then, the statistical data of students’ learning activities are analyzed. At the same time, other high-quality curriculum resources should be recommended, such as the National Excellent Course taught by Pei-zeng Gong of Tongji University on the MOOC platform of China University.
- Under the clear result-oriented guidance of the learning task list, students conduct autonomous learning according to their own actual situation, and conduct a diagnostic evaluation of the effectiveness of autonomous learning through real-time tests. Teachers adjust the teaching design in time according to the feedback of the learning situation. Before the class, the main goal is to achieve basic learning, give full play to the advantages of online courses that are not restricted by time and space, and realize the transfer of knowledge before class.
- In class, teachers answer the learning difficulties based on the feedback of the learning situation of preview before class. The knowledge points are combed in a focused and targeted manner to help students to check for deficiencies and consolidate new knowledge, guide by the OBE education concept, they create some open questions which are certainly complex, comprehensive and challenging, with the purpose of guiding students to carry out in-depth thinking, discussion and exploration of "integration of reason and reality" [7], and developing in-depth interaction through the form of "I ask you to answer". Through showing students’ works and letting them share their experience, we try to create students' sense of participation and develop output learning. We make live programming demonstrations of practical cases to promote the development of

students to the level and depth of professional core literacy. In the class, the main goal is to achieve advanced learning and attain the complementarity and organic integration of the advantages of online and offline.

- After the class, by carrying out high-cognition + high-behavior activities through open experimental assignments, the improvement of knowledge and ability is further achieved. Teachers give full play to the role of "leverage", carry out personalized counseling, and realize interactive discussions and experience sharing between teachers and students. After class, the main goal is to achieve innovative applications, to realize innovation and expansion, additionally, to make the application of learning.

D. Developing teaching evaluation standards

This course adopts a variety of assessment methods, including two aspects: process evaluation and result evaluation. Its score composition is shown in “Table II”.

TABLE II. THE RELATION BETWEEN TALENT TRAINING GOALS AND COURSE TEACHING OBJECTIVES

Project	Weight	Assessment method	Proportion
Process evaluation	50%	experimental report homework teaching task points chapter quiz class interaction check in online visits number of discussions	30% 15% 15% 15% 10% 5% 5% 5%
Result evaluation	50%	closed book examination with computer	50%

IV. RESEARCH AND IMPLEMENTATION

In order to ensure the comparability of the research, the author chose classes 2102, 2202 and 2205 (a total of 229 people) as the pilot class, and classes 1103, 1207 and 1208 (a total of 204 people) as the comparison class. In the case of ensuring no difference in other conditions, the pilot class adopts the "3 + 3" online and offline blending learning mode based on the OBE education concept, and the comparison class continues to use the traditional teaching mode. After a full cycle of teaching practice, teachers will know the real situation and analyze through the learning situation, student learning behavior, mark and other aspects, then take them as the evaluation standard of teaching research.

A. Learning situation analysis

At the end of the semester, a total of 433 questionnaires are issued, and 416 valid questionnaires are returned, with an effective recovery rate of 96.1%. The questionnaire conducted self-study surveys from five aspects: curriculum attitude, teaching mode, learning experience, learning effect and ability evaluation. The data shows that this course is highly popular, and the pilot class' evaluation of the new teaching method's recognition, enthusiasm and learning situation outcomes is significantly better than the comparison class, as shown in “Fig. 2”.

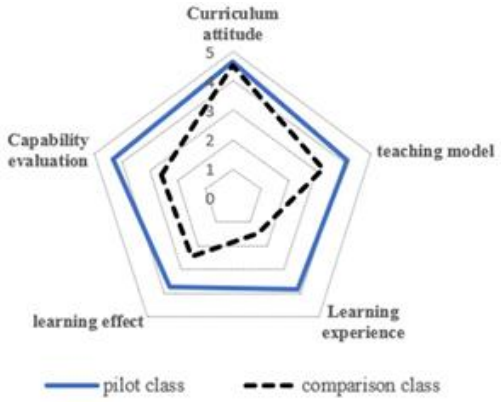

Fig. 2. Comparative analysis of learning situation.

B. Student behavior analysis

We utilize the big data statistics function of "Super Star Learning Pass" to make statistics and analysis of the students' learning behavior data.

1) Learning tools: In the learning process, 64.19% of the students use mobile clients, while 35.81% of them use the computer web version, as shown in “Fig. 3”. The data shows that mobile devices is more popular due to their characteristics of convenient portability, flexible control, effective continuity of learning and so on.

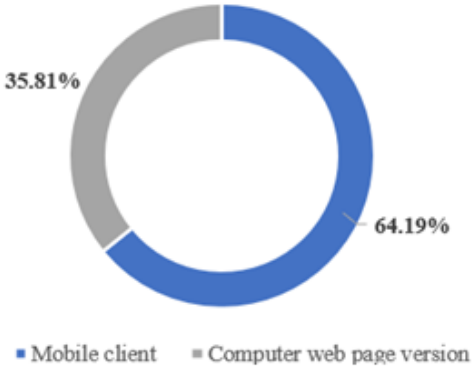

Fig. 3. Statistics of learning tools.

2) Access frequency: The average number of total visits of the pilot class on "Super Star Learning Pass" reached 16372.Taking the class 2102 as an example, the total number of visits of this class in March 2019 was 5652 times, as shown in “Fig. 4”. Among them, on March 10 (Sunday), the number of visits reached a peak of 602, and the number of visits on weekends increased more than weekdays. The data shows that students have a higher learning enthusiasm, and they can actively participate in online learning activities. Students have changed from traditional passive learning to active learning, and their learner autonomy has been cultivated.

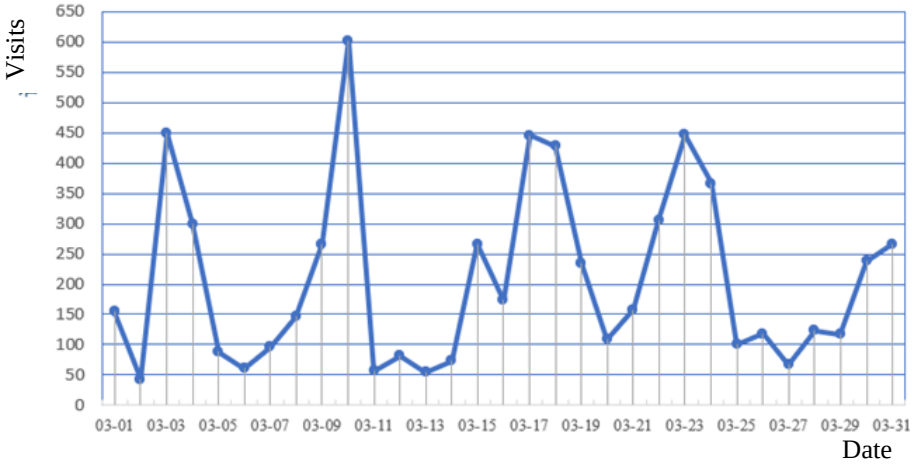

Fig. 4. statistics of access frequency.

3) Task point progress: In the process of teaching implementation, a total of 33 video task points are distributed for total 211.75 minutes. The completion of the task points is shown in “Fig. 5”. Among them, the task completion ratio reached 70.6%, the average viewing time was 124.8 minutes, and the longest viewing time was 429.3 minutes. The data shows that students are better at learning and willing to learn under the new mode. Course resources are effectively used, and students have more independent choices in the learning process, which fully meets the individualized learning needs.

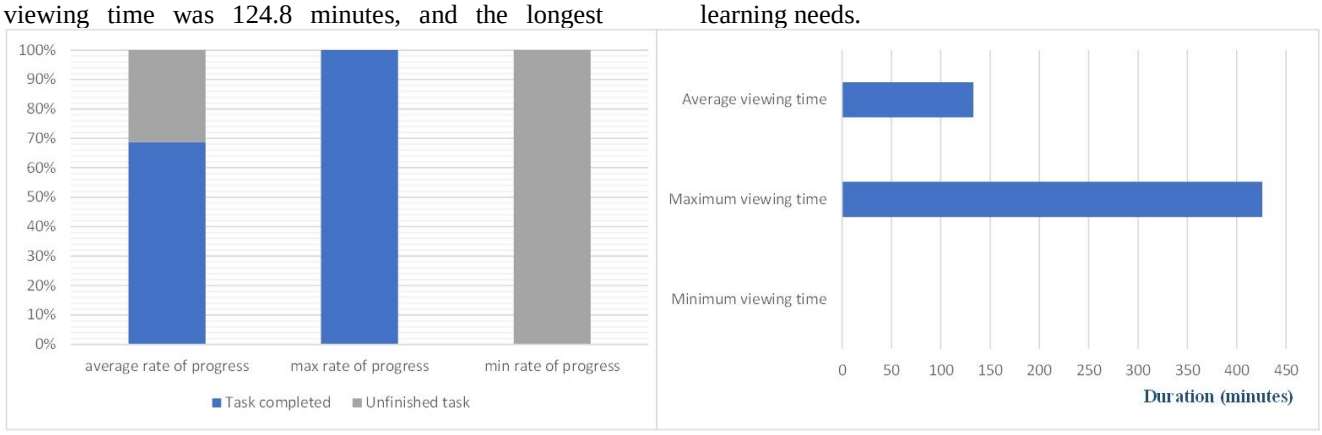

Fig. 5. Progress statistics of task points.

C. Analysis of teaching effect

Making analysis of the results before and after the intervention adopting the way of unified proposition and separation of teaching and testing, we use SPSS20.0 to conduct a paired sample T test for the pilot and comparison classes. Comparative analysis of the results before and after the intervention is shown in "Table III" and "Table IV".

TABLE III. COMPARATIVE ANALYSIS OF RESULTS BEFORE INTERVENTION

Class	N	Mean	SD	Pass rate	t value	p
Pilot class	229	65.43	19.43	61.04%	-0.499	0.618
Comparison class	204	66.95	17.58	74.65%		

TABLE IV. COMPARATIVE ANALYSIS OF RESULTS AFTER INTERVENTION

Class	N	Mean	SD	Pass rate	X2	t value	p
Pilot class	229	72.76	18.18	76.62%	15.530	3.719	<0.001
Comparison class	204	57.64	21.23	45.07%			

The data shows that the results of the pilot class before the intervention (M=65.43, SD=19.43) and the results of the comparison class (M=66.95, SD=17.58) are in good agreement, and the overall degree and difference between the two groups of students are not large. The total score after intervention (M=72.76, SD=18.18) of the pilot class is significantly higher than that of the control class (M=57.64, SD =21.23), which is statistically significant. The T value is 3.719, and the p value is less than 0.001, which further verifies the blending learning's advantages and feasibility.

The final test paper after intervention is composed of objective questions and subjective questions. Among them, objective questions include multiple choice questions and judgment questions, and subjective questions include program design questions and form design questions. The comparative analysis of the results of objective questions and subjective questions is shown in "Table V" and "Table VI".

TABLE V. COMPARATIVE ANALYSIS OF THE RESULTS OF OBJECTIVE QUESTIONS AFTER INTERVENTION

Class	N	Mean	SD	Pass rate	X2	t value	p
Pilot class	229	47.78	9.77	88.32%	7.315	4.596	<0.001
Comparison class	204	41.31	11.27	70.42%			

TABLE VI. COMPARATIVE ANALYSIS OF THE RESULTS OF OBJECTIVE QUESTIONS AFTER INTERVENTION

Class	N	Mean	SD	Pass rate	X2	t value	p
Pilot class	229	24.99	11.12	63.64%	21.852	4.674	<0.001
Comparison class	204	16.33	11.80	25.35%			

From the experimental results, it can be seen that the results of objective questions in the pilot class (M=47.78,SD=9.77) and the comparison class (M=41.31,SD=11.27); the results of subjective questions in the pilot class (M=24.99, SD=11.12)and the comparison class (M=16.33, SD=11.80). The pilot class is more prominent in solving the subjective problems which have higher requirements for ability, and it can be inferred intuitively that the "3 + 3" blending learning with OBE education concept can train students' ability effectively.

D. Teaching reflection

This research has played an important role in further deepening the teaching reform and initiating the construction of "Golden Class" in an all-round way, stimulating the endogenous driving force of teaching

reform. At the same time, it urges teachers' thinking and action on the replacement of old and new teaching concepts. Deep integration of information technology and education realizes the transformation from traditional teaching to "precision" teaching based on teaching big data; teachers change from leaders to guides; students change from passive listening to active learning; the focus of curriculum assessment changes from results evaluation to process evaluation. Many changes indicate the positive interaction of teaching and the development of teaching reform.

V. CONCLUSION

The "3+3" blending learning practice of "Computer Programming" based on the OBE education concept realizes the deep integration of information technology and education teaching. To a certain extent, it promotes the curriculum construction and classroom teaching reform under the background of "new engineering". It promotes the sharing of high-quality teaching resources and optimizes the ability cultivation of application-oriented talents, so it needs further in-depth research.

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