

Exploration and Practice of Tiered Customized Blending Learning Based on Data Center Platform

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Abstract: In the mixed teaching practice, this paper is based on the construction of a complete multi platform, multi-objective, gradient, personalized, refined and immersive teaching resource environment; The whole process of teaching and learning is recorded digitally, and the artificial intelligence algorithm is integrated synchronously to realize the personalized and refined real-time evaluation of students' learning status in the teaching process; Through the newly designed "mixed teaching data console", the "data flow" connects all links of course teaching schedule, students' autonomous learning and teachers' teaching control, so as to achieve effective control of teachers' teaching process; Through personalized and refined reconstruction from the five links of teaching, learning, management, testing and evaluation, an intelligent hierarchical personalized supervision and guidance system based on data fusion is established to achieve the personalized teaching goal in mixed teaching.

1. Introduction

Blending Learning is a teaching mode that combined online and offline resources. In this mode, the teaching form is changed to independent online learning for students, and the whole teaching process is controlled by teachers using various means[1]. In the actual implementation of blending learning, the control scope of the teacher is expanded from the original traditional classroom to offline classroom and online classroom as well as students' extracurricular learning norms. Then, students learn online independently and finish the learning process according to teachers' requirements. In this way, teachers can pay attention to students' online and offline learning status, which helps design the supervision and guidance methods, thus reaching the teaching goal. Blending learning has the following characteristics:

Variation of teaching spatial and temporal scope[2]. In terms of space, teachers need to pay attention to the independent learning outside the classroom, including the collaborative allocation of various online resources, except offline and online classrooms. In terms of time, teaching time is changed from the original 45-minute classroom to the entire process from the beginning to the end of the course.

Variation of offline classroom function. Traditionally, the main task of teachers in offline classrooms is to teach knowledge. However, in blending learning, students are the center, and teachers' responsibilities change to control the whole teaching process.

Custom-teaching of the online classroom. The online classroom is for students to carry out independent learning under the supervision of teachers, which is different from extra-curricular learning, and teachers need to give clear learning objectives. To some degree, different teaching strategies should be given to adapt to students of different learning levels.

Blending learning focuses on students' independent learning, which leads to a more significant problem of custom-teaching, that is, how to control effectively in custom-teaching of blending learning[3]. Since 2015, the team of Computer Fundamentals Course in Jiangnan University has applied blended learning to the custom-teaching practice of the general education course "University Computer Fundamentals". In this practice, information technology is combined deeply with the

teaching process. Moreover, a data-driven multi-level customized blending learning model and specification based on the data center is built and improves the comprehensive teaching quality. [4]

In the specific practice of blending learning, the following significant problems are focused on:

Customized evaluation to students. During the teaching, almost every student's learning status varies on their abilities, goals, needs, and other factors. In this situation, only with real-time and refined learning status data from students can teachers personalize the teaching strategies.

Online and offline combination mechanism. Students and teachers are dual subjects. On the one hand, students learn independently with teachers' standardized requirements. On the other hand, teachers control online and offline classes with the real-time learning status of students. The two-way interaction feedback of both sides needs to form a closed loop.

Collaborative specification of customized learning resources. In the blending learning, diversified students' needs, the networked learning environment, specialized teaching platform, and enlarged teaching resources need to collaboratively reconstruct teaching resources, teaching methods and teaching processes to form a unified, collaborative, and standardized teaching system, in order to support custom-teaching.

Intelligent control of teaching process. In the blending learning, teachers are concerned about the achievement of teaching goals and need effective control means in the face of many students. [5]

2. Exploration and Practice

2.1. Framework of Blending Learning

In the blending learning, the whole teaching process is standardized and controlled by constructing "a blending learning data center". The blending learning data center is a five-integrated data center of "environment + center + application + data + resources", which is built by collaborative combined teaching, learning, management, test, and evaluation, in order to achieve full coverage of teaching scenarios and full penetration of educational information and to realize customized and refined learning. The framework of blending learning data center is shown in the Figure 1.

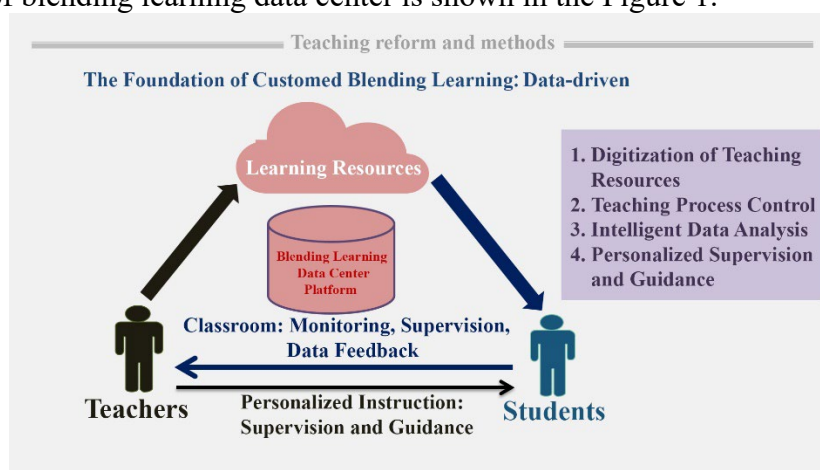


Figure 1 The framework of blending learning data center.

In the course control, the data center firstly constructs the modular teaching schedule in stages according to the course and sets the assessment nodes, and synchronously supports the multi-platform collaborative gradient diversified customized refined teaching resource system. Then, at the assessment nodes, it collects the teaching and learning data of each teaching platform, forms the customized learning evaluation of students according to the data, and provides timely feedback to students. In addition, teachers carry out the customized strategies and supervise and guide students according to the teaching specification.

Specifically, in the "University Computer Fundamentals", the multi-level custom-teaching mode with blending learning data center is realized by built a multi-platform architecture. The flow chart of data-driven Tiered blending learning mode is shown in the Figure 2.

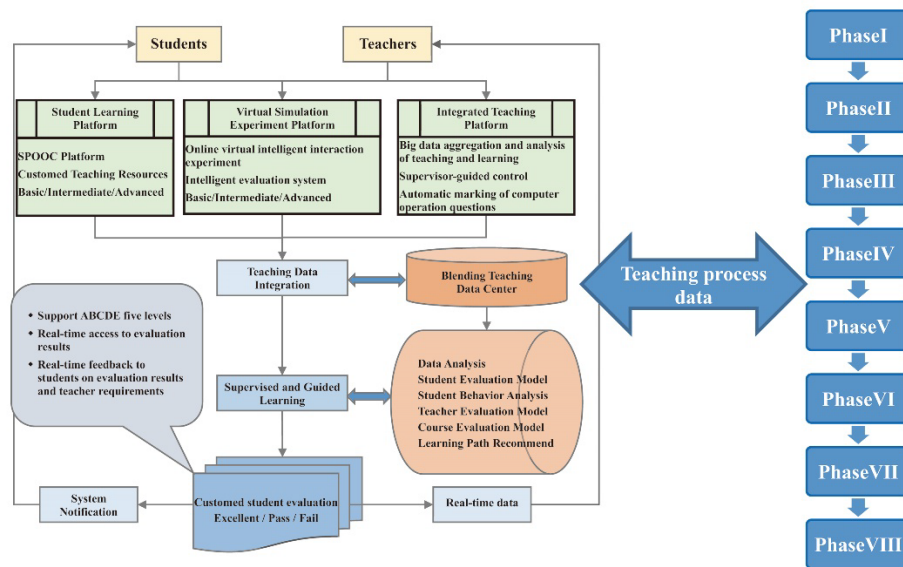


Figure 2 Data-driven Tiered blending teaching mode.

2.2. Implementation of the Blending Learning in the "University Computer Fundamentals"

2.2.1. 8331N System

The 8331N system is centered on a "blending learning data center" and is based on a reconstructed teaching system from three aspects of teaching resources, process, and assessment methods. The framework of the 8331N system is shown in Figure 3.



Figure 3 8331N system.

The practice of the "University Computer Fundamentals" course is divided into 8 stages, in which the basic, intermediate, and advanced learning courses are constructed in 3 teaching platforms, namely, student learning platform, virtual simulation experiment platform, and teacher comprehensive platform. Moreover, the specific course videos, assignments, exams, discussions, notices, PBL grouping activities and other diversified learning resources are related. It is worth mentioning that the basic and intermediate courses are compulsory for all students, and the advanced courses are optional.

A "blending learning data center" is adopted to converge, clean, and integrate various teaching process data of 3 platforms in real-time at preset evaluation nodes. Then, N kinds of student learning status evaluations and N kinds of evaluation systems for teachers, courses, and teaching are formed by analyzing these process data using artificial intelligence algorithms. From the above 8331N process, closed-loop feedback is obtained to provide timely feedback to students on evaluation results which helps to refine learning indicators and personalized progress and goals of each student.

Teachers give a lecture and supervise and guide students according to teaching specifications which are determined by real-time evaluation data at teaching nodes. From the perspective of the offline classroom, various resources are adopted to control students' learning status. From the

perspective of the online classroom, key supervision is implemented for students who do not reach the preset goals, and at the same time, those who reach the standards, are guided to learn advanced courses. The data from each stage after supervision forms the final evaluation of each stage. All stage evaluations constitute the students' usual course grades.

2.2.2. Deeply Combination of Various Resources

Blending learning needs to meet the needs of both students and teachers, and the characteristics of different courses are different, in which a trend of multi-platform emerges. In practice, 3 major functional platform architectures have been explored and formed.

Student learning platform. It relies on the Super Star platform to build a high-quality catechism resource (course videos, assignments, exams, discussions, notifications, and other learning resources) and builds a basic, intermediate, and advanced three levels of the graded teaching resource system.

Virtual simulation experiment platform. It relies on the Wisdom Tree platform to build a gamified online independent experiment platform. A game completion mode is designed by learning gradients such as basic, intermediate, and advanced, which lead students to reach customized and immersive learning goals.

Comprehensive teaching platform. A self-developed teachers' teaching supervision and guidance control platform is built which has obtained software copyright. The functions include the following part: teachers' assessment of students' learning stages, convergence and analysis of online and offline blending learning data, supervision, and guidance of teaching under teacher-student interaction. The platform can make refined portraits and custom analyze students' learning by artificial intelligence algorithm.

2.3. Application Effect

2.3.1. Students' Course Learning Performance Improved Significantly

The comparison graph of the raw grades of the final exams in 2017-2020 is shown in Figure 4.

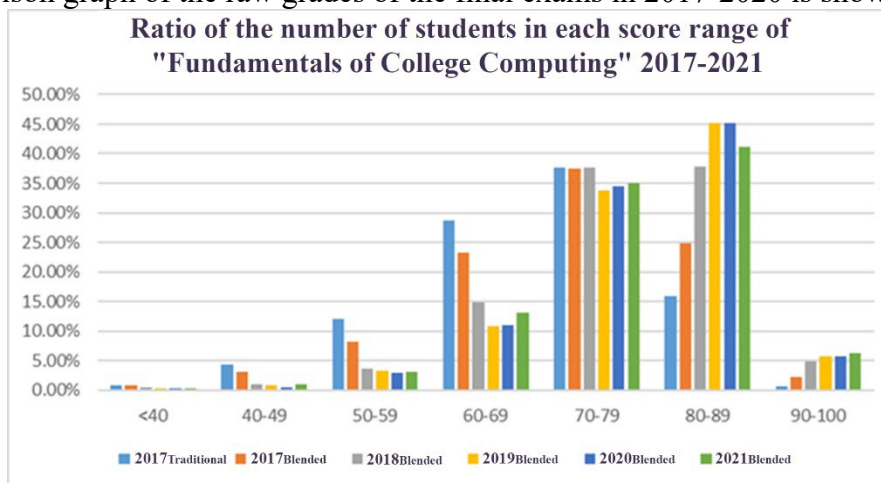


Figure 4 The comparison graph of the raw grades of the final exams in 2017-2021.

It can be seen in Figure 4 that between 2017 and 2020, the merit rate of students increased significantly and tended to stabilize, and failing students decreased significantly.

2.3.2. The Effect of Supervisory Guidance in the Teaching Process is Obvious

Taking 2021-2022-1 semester university computer foundation course class 045 as an example, there are 7 stages of supervision, and the supervision time is 1 week. The effect is shown in the Figure 5.

It can be seen in Figure 5 that from the supervision effect, giving 1 week for supervision each time can effectively urge the midstream students to catch up with their study progress, and has a good warning effect on the students who have the tendency to slack off in the study process. Except for individual chapters with high difficulty, most of the chapters studied ended up with a relatively high

pass rate for students.

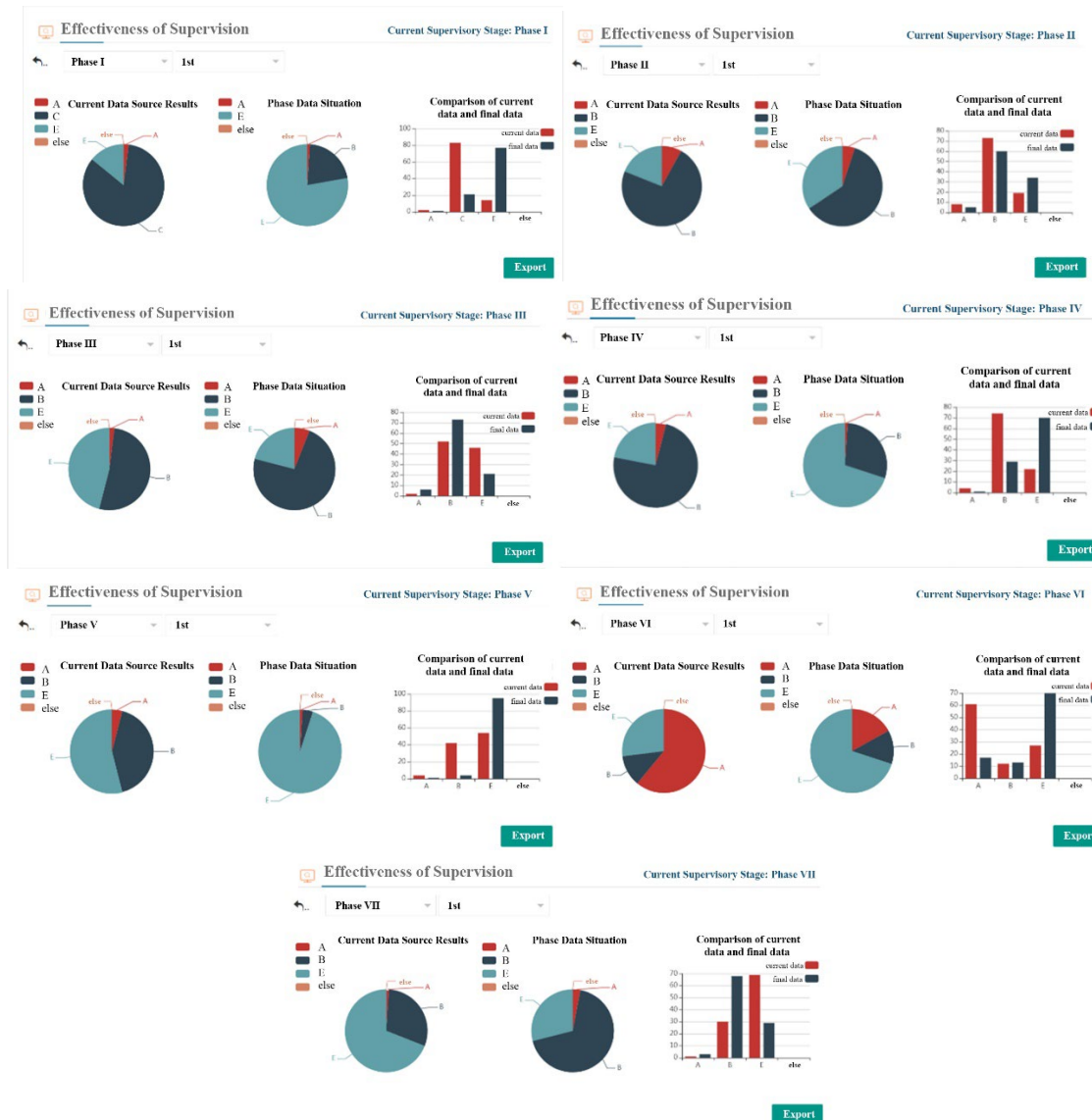


Figure 5 Class 080714-045 before and after comparison of seven stages inspector.

From the implementation results, students' self-learning awareness and self-control ability are obviously improved. Under the blending learning, each student has his or her own learning pace and learning mode, and teachers focus on students with learning difficulties and guide capable students through heuristic teaching to achieve a great improvement in students' self-learning ability.

3. Innovation and Development

In this paper, an intelligent, perceptive, ubiquitous teaching new ecology is designed, which comprehensive considering "things, people, teaching and education", based on the Internet, big data, artificial intelligence, and other new generation of information technology, aiming at ultimately forming a personalized, refined teaching model to improve the quality of teaching. The main characteristics of this teaching new ecology can be included as follows:

Innovation of evaluation system: It realizes the customized and refined real-time evaluation of students' learning status in the teaching process for the first time by adopting the digital record of the whole process of teaching and learning as well as the integration of artificial intelligence algorithms. In this part, the teaching and learning data are collected, cleaned, and integrated by setting the teaching evaluation nodes. Then, an intelligent big data analysis model is adopted to obtain customized, refined and real-time evaluation of students' learning status. The evaluation data of all nodes are finally gathered into the overall evaluation of students' courses, which is a comprehensive and

complete record of students' learning process. At the same time, it can also provide evaluations about teacher teaching evaluation, course evaluation, teaching management, and other aspects.

Innovation of teaching control means: It realizes effective control of teachers' teaching process by a new designed "blending learning data center", which connects the course teaching schedule, students' independent learning, and teachers' teaching control through "data flow". In this part, teachers achieve simultaneously organize teaching, publish, set teaching tasks, and control the teaching process in the center platform. At the same time, students obtain the current learning information in the center platform, including the prescribed learning progress, customized learning status, and learning tasks. The center platform run through the objectives, resources, evaluation, and control of the teaching process, integrating "environment + center platform + application + data + resources", realizing the full coverage of teaching scenarios, and integrating online and offline teaching.

Innovation of customized teaching mode: It realizes the establishment of an intelligent, tiered, and customized supervision and guidance system based on data integration by reconstructing the five links of teaching, learning, management, testing, and evaluation in all aspects customized and refined. Based on the syllabus and teaching schedule, multi-stage teaching assessment target nodes are set and a complete multi-platform multi-objective gradient customized, refined, and immersive teaching resource environment is built. In the teaching process, node process data are collected to conduct intelligent analysis and form personalized and refined evaluation indexes for students. Then, a teacher can design customized supervision and guidance based on an objective understanding of each student's learning status.

The achievement proposed in this paper realizes a standardized example of customized blending learning supported by computer system, which has excellent scalability and can be applied to other related general education courses, basic courses, and professional courses.

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