The Teaching Mode and Evaluation of Computer Course in Higher Vocational Colleges in the Intelligent Era

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Abstract. The intelligent era brings new opportunities and challenges to the development of higher vocational education, requiring higher vocational colleges to train high-quality compound skilled talents. However, the current higher vocational students have a poor learning foundation and lack the motivation to learn, so it is necessary to reform the training of talents and the traditional classroom teaching mode of higher vocational colleges. Based on the specific teaching practice of the computer "Bilingual C Programming" course on the intelligent cloud platform, this paper explores the unique characteristics of higher vocational teaching under the background of mobile Internet and big data technology, according to different learning conditions and different teaching environments. Combining multiple teaching modes organically, achieving complementary advantages through the use of online and offline mixed teaching, using flipped classroom and PAD (Presentation Assimilation Discussion) class teaching modes, and adopting process evaluation methods to achieve teaching goals of "teaching with improvement, learning with achievement, teaching and learning mutually beneficial". The results of empirical research show that the students who adopt the flipped classroom and the PAD class teaching mode show good learning results and stronger learning motivation.

Keywords: Higher vocational teaching research · Classroom teaching mode · Flipped classroom · PAD (Presentation Assimilation Discussion) class

1 Development and Reform of Higher Vocational Education in Intelligent Era

The "nuclear fusion reactions" of the new generation of information technologies, represented by big data, intelligence, mobile Internet 5G, and cloud computing, have pushed human society into an intelligent era. The new round of scientific and technological revolution not only makes the development of China's higher

S. Shi et al. (Eds.): 6GN 2021, LNICST 439, pp. 493–512, 2022.
https://doi.org/10.1007/978-3-031-04245-4_43

vocational education get unprecedented opportunities but also brings many challenges, which makes the reform of talent training and traditional classroom teaching mode more urgent.

1.1 Opportunities for Development

National Strategies and Policies Indicate the Direction of Higher Vocational Education Reform and Development in the Intelligent Era. To build the first-mover advantage and grasp the initiative of the new round of scientific and technological revolution strategy, the Chinese State Council issued the "Guideline: A New Generation of Artificial Intelligence Development Plan" [1] puts forward: improve the artificial intelligence education system, strengthen the cooperation between industry, university, and research, and meet the demand for high-skilled jobs brought by the development of artificial intelligence in China. This national strategic guideline points out the direction for the talent cultivation of higher vocational education and aims to cultivate high-end and adaptable talents meeting the needs of the intelligent era.

To carry out a comprehensive reform to the vocational education sector, the Chinese State Council published its "National Vocational Education Reform Implementation Plan" [2], strengthened vocational education is a different form of education from its main-stream counterpart but of equal importance and raised the importance of vocational education to the status of "no vocational education modernization, no education modernization". The reform plan requires: to establish series of vocational education national standards, including teaching standards, curriculum standards, and other standards, and vocational colleges and universities to independently formulate talent training programs according to the standards; to promote the reform of "three aspects of education" in the field of vocational education and strive to realize the high integration of vocational skills and professional spirit training. Major construction and curriculum construction are the most important in the development of vocational education, and it is also the key to training talents in vocational education. The introduction of this reform plan points out the direction of reform and provides important and specific guidance for a series of construction activities such as the professional construction and curriculum development, setting, and implementation of vocational education.

Meanwhile, the Chinese State Council published a significant plan "China's Education Modernization 2035 Plan" [3] to drive continued reform in and advancement of China's education sector. And the Ministries of Education and Finance issued a national level development plan "Instructions on implementing the construction plan of high-level higher vocational schools and majors with Chinese characteristics" [4] (Double High-Level Initiative). In the reform development task of vocational education, it is clear that: to promote the integration of information technology and intelligent technology into the whole process of education, teaching, and management, and to integrate the means of big data and artificial intelligence to promote the transformation of school management

mode, to meet the demand of "Internet + vocational education", and to promote the co-construction and sharing of digital resources and educational data, and widely apply online and offline mixed teaching, to promote autonomous, ubiquitous, personalized learning. This points out the specific direction for the teaching mode and management service reform of higher vocational education.

The Innovation of Intelligent Technology Provides Technical Support for the Development of Vocational Education. With the wide application of intelligent technology in the field of education, it promotes the intelligent development of vocational education to realize all-round multi-level intelligent development of "learning, teaching, and management", and promotes the intelligent study, teaching, and management, which injects new vitality into the development of vocational education.

(1) *In terms of learning,* the intelligent age makes personalized autonomous and ubiquitous learning a reality. With the breakthrough of artificial neural network technology, big data and cloud computing technology, expert system, natural language understanding, and other technologies, many products such as learning resource systems, intelligent teaching systems, and collaborative learning systems supported by big data and cloud platforms are pushed into the market, students can realize autonomous, personalized and ubiquitous online learning through mobile terminals with seamless access to learning services. At the same time, with the development of big data driven learning analysis technology, students' learning needs, learning behaviors, learning process, and learning results can be quantitatively analyzed, which can provide learners with personalized feedback and provide a great convenience for personalized autonomous learning.
(2) *In terms of teaching,* the educational technology and teaching in the intelligent era are fully integrated, and the rich knowledge construction tools provide abundant teaching resources, teaching methods, and convenient technical conditions for teachers' high-quality teaching. The extensive application of online and offline hybrid teaching methods enables between students, and between teachers and students to communicate, share, cooperate, and question each other in the process of exploration, building a "learning community". In the core link of vocational education, it is possible to break through the time and space limitations of teaching and learning, and build smart classrooms, virtual training scenes, and virtual factories through various information technologies and artificial intelligence technologies such as Virtual Reality (VR), Augmented Reality (AR), online industrial skills, etc. It enables students to learn and train in a more realistic and immersive intelligent experience situation, which helps to fully mobilize students' interest in learning.
(3) *In terms of management of teaching quality,* various intelligent technologies such as data mining and learning analysis are applied in the intelligent era to analyze students' individual learning habits and the distribution of learning situation of the whole class, making the management and evaluation of

education and teaching more standardized, refined, efficient and scientific. Especially in the evaluation of talent training, with the support of intelligent technologies such as big data and deep learning, the intelligent evaluation and evaluation system is used to track the learning situation of students in the whole process, real-time and continuously, and analyze various data such as students' learning performance and activity participation, so as to realize the overall evaluation of students' learning process and objective and accurate result feedback, to promote the overall evaluation of students' learning process. At the same time, the teaching mode, teaching design, and on-the-spot teaching of teachers should be evaluated scientifically, comprehensively, and comprehensively to promote intelligent teaching.

1.2 Challenges to Development

The rise of artificial intelligence makes social production increasingly automated and intelligent, and large-scale "machine replacement" brings a strong impact on the labor market, which brings severe challenges to the development of higher vocational education.

The Development of Higher Vocational Education in the Intelligent Era Must Deepen the Talent Training Mode of Integration of Production and Education. In the intelligence era, the global Internet technology enterprises have shifted their development focus to the field of artificial intelligence. The intelligence of enterprises is becoming more and more obvious. Under the emerging industrial pattern, the demand for talents from the market and enterprises continues to increase, and more attention is paid to the high integration of vocational skills and professional spirit training. However, the talent training in higher vocational colleges is often difficult to keep up with the market demand for talents. To solve these problems and realize the precise and effective supply of talents, only by deepening the school-enterprise cooperation of industry and education integration can we promote the organic connection of education chain, talent chain, industry chain, and innovation chain, and build a new intelligent vocational education ecosystem.

The National Development and Reform Commission and the Ministry of Education issued the "National Pilot Implementation Plan for the Construction of Integration of Industry and Education" [5], which clarified the principles, conditions, and support policies for the construction of an industry-education-integrated enterprise in China, and regarded the construction of an industry-education-integrated enterprise as a modern enterprise system. The important direction is to adopt a combination of policies to guide and encourage enterprises to participate in the reform of integration of production and education and to further open up the supply and demand of the talent training system and the technological innovation chain. But in reality, the school-enterprise cooperation with industry-education integration still faces many challenges in practice.

The Majors Setting and Development of Higher Vocational Colleges Are Facing New Challenges in the Intelligent Era. In the intelligent era, new industries and enterprises are constantly emerging, and a large number of talents are urgently needed in new professional fields. Serving the regional economic and social development is the premise of vocational education majors setting. To connect the economic development and industrial upgrading, higher vocational colleges must do a good job in the forward-looking prediction and planning of majors setting, so as to realize the professional chain docking with the industrial chain. Through the establishment of the dynamic adjustment mechanism of majors, new majors should be added, or obsolete majors should be canceled according to the industrial development trends.

Furthermore, intelligent production has become the main production mode of enterprises, which has a profound impact on the working mode and the skill requirements of talents, and there will be a general phenomenon of professional integration and professional crossover. Therefore, higher vocational colleges should pay attention to the majors' team construction, set up wide adaptive majors, adjust and integrate traditional majors and new majors, face the general purpose jobs, and realize the integration and application of multidisciplinary knowledge, and strengthen the adaptation to career migration of students across positions, deep levels, diversification, systematization and professional quality, to effectively meet the demand of the new job market for high-quality, high-skilled, compound and applicable talents.

The Professional Teaching Content of Higher Vocational Colleges Must Be Updated in the Intelligent Era. The current teaching content of Higher Vocational Education in China is mainly based on the requirements of industry 3.X, namely the automation and information age, for talent training. With the arrival of the intelligent era, China's industry has entered the 4.0 intelligent era. Therefore, higher vocational colleges must take the initiative to reform and develop, respond to the demands of the times with a new attitude, and promote the ecologically sustainable development of higher vocational education, pay more attention to the new knowledge and new skills involving human-computer cooperation, and increase the AI course to learn artificial intelligence knowledge.

1.3 Urgency and Necessity of Reform the Traditional Classroom Teaching Mode

With the advent of the intelligent era, the goals and standards for talent training are increasing day by day, and it is necessary to cultivate compound talents with technical skills. In addition, the popularization of higher education has resulted in the decrease of admission barriers and the quality of students. The increasing "scissors gap" between "entry and graduation" colleges have brought huge challenges to the training of traditional talents in higher vocational colleges, making the reform of traditional classroom teaching mode more urgent and necessary:

(1) *The traditional classroom is teacher-led type.* Teachers give priority to teaching and students passively accept knowledge, which makes students lack the initiative in learning.
(2) *The traditional classroom teaching mode cannot adapt to the requirements* of autonomous ubiquitous learning in intelligent education in the intelligence era. At the same time, it cannot adapt to the popularization of mobile terminals and the fragmented time for learning.
(3) *Higher vocational students have poor admission scores and poor study habits.* After entering the colleges, many vocational students lose the motivation and goal of learning, the absentee rate is high, the phenomenon of playing mobile phones in class and not listening carefully is common, and the time after class is more likely to be wasted.

How to fully mobilize the inner driving force of higher vocational students to study, change the status quo and improve teaching has become a very urgent task. It has also become a more urgent task in the reform of classroom teaching mode that students can make full use of classroom and spare time.

2 Analysis of Current Classroom Teaching Mode and Teaching Reform in Higher Vocational Education

Vocational higher education and general higher education are two different types of education. They have the same important status [2] and follow the basic teaching rules. At present, the following classroom teaching modes are mainly used in higher vocational colleges:

2.1 Lecture Teaching Mode

The lecture teaching mode has dominated world teaching for nearly 400 years and has become synonymous with traditional teaching. The traditional lecture teaching mode is led by teachers, explains concepts, narrates facts, demonstrates principles, and completes the presentation of established content to students through oral language. The lecture teaching method is economical, simple, and large in knowledge capacity, which is conducive to greatly improving the effect and efficiency of classroom teaching, helping students systematically master basic knowledge, forming basic skills, and improving cognitive structure, and is conducive to giving full play to the leading role of teachers [6]. It is the foundation of other teaching modes.

However, the essence of the lecture teaching mode is passive learning. There are fundamental defects of low student participation and initiative, which is not conducive to taking into account individual differences of students, and it is easy to make poor students feel frustrated and gradually lose their motivation to learn. In the intelligent era, especially when higher vocational colleges emphasize practical teaching today, the core defect that the lecture teaching mode is a passive classroom is thoroughly exposed.

2.2 Teaching Mode of Team Learning Based on Discussion

The teaching reform in the last century has tried to break through the traditional lecture teaching mode. The most important achievement is the new teaching mode of team learning based on discussion. This is a creative teaching theory and mode commonly used in many countries in the world. Because of its remarkable effectiveness, many famous foreign universities regard this mode as the second-largest teaching mode after classroom lecture teaching.

Team learning is a teaching activity in which teachers assign learning tasks and control teaching processes, take team cooperation as the basic form, evaluate the criteria with team performance, and mutual assistance and cooperation among peers in classroom interactions to jointly achieve teaching goals [7]. The teaching mode of team learning based on discussion is based on heuristic teaching ideas. Teachers prompt and guide students to think actively and improve their initiative and participation [8], especially in the teaching method of "learning by doing" for vocational students played an extremely important role.

The teaching mode of team learning based on discussion mainly follows the basic process of lecture teaching mode, however, this method, especially the discussion session, it has higher requirements for teachers' subject quality and classroom control, as well as students' learning motivation and investment. More importantly, this mode makes the knowledge learning system not strong enough, not efficient enough, and the effect is not good enough, so it is greatly limited in practical application.

2.3 Case-based Teaching and Problem-Based Learning

The Case-based teaching mode is the process of typifying real situations in real life and forming case libraries, allowing students to complete the learning of the established teaching content through independent research and mutual discussion [9]. PBL (problem-based learning, project-based learning) teaching mode allows students to place themselves in complex and meaningful problem situations by designing authentic project tasks, and solve the problem through independent exploration and cooperation, get the subject knowledge behind the problem [10]. The essence of this kind of teaching mode is opposed to the traditional one-way lecture teaching mode, focusing on students to learn knowledge and develop abilities by completing tasks, doing projects, or solving problems. This kind of teaching method is very suitable for the integrated classroom teaching mode of teaching, learning, and doing under the background of the integration of production and education in higher vocational colleges to highlight the practical ability of students.

Cases, problems projects, and projects in case teaching mode and PBL learning mode are the core advantages of the teaching mode, but they are also the fundamental difficulties. Cases, projects, and tasks emphasize their authenticity and complexity and hope that they can be typical and open, and can systematically cover the knowledge that needs to be learned. This requires high requirements for collecting, compiling, and constructing case libraries, project libraries,

and problem libraries, which has become the main obstacle to the promotion and popularization of this kind of teaching mode.

2.4 Flipped Classroom and MOOC

In the past two decades, two major teaching reform modes that have emerged worldwide are flipped classrooms and MOOCs.

The flipped classroom teaching mode requires students to learn new content by watching a class lecture video before arriving at class and then using the in-class time to practice, discuss, and solve problems with peers and teachers, so as to achieve a deep understanding of learning content [11]. This teaching mode inverts teachers' and students' responsibilities in classrooms, the decision-making power of learning is transferred from teachers to students. With the precious time in the classroom, students are required to actively plan their learning process and interact with peers and teachers to acquire knowledge, focus more on active problem-based and project-based learning, making their learning more flexible, active, and more participatory.

Massive open online courses (MOOCs) are a novel and emerging mode of online learning activities for large numbers of participants worldwide. The MOOC has a wide audience and a large number of students, breaking through the time and space limitations of traditional courses, and everyone can participate. MOOC integrates a variety of social network tools and various forms of digital resources. They offer the advantages of online learning and provide content including short video lectures, digital readings, interactive assignments, discussion fora, and quizzes [12]. Student learning, teacher guidance, and Q&A, and assessments are all carried out online. MOOC uses the Internet to build virtual classrooms, creates high-quality courses through famous teachers, and improves the efficiency of knowledge transfer through scale, which is convenient for improving teaching quality, reducing higher education costs, and enhancing education equity. In higher vocational education, the requirements of intelligent vocational education and the introduction and comprehensive application of related products have promoted the reform of vocational teaching education and education and promoted the construction of a learning-oriented society. However, in practice, many factors restrict the development of MOOCs, such as teacher-student interaction, student-student interaction problems in a large-scale environment, high dropout rates, and poor effects of online learning, especially for higher vocational students with poor learning initiative. The inability to solve the problem directly led to the low level of MOOC development worldwide.

2.5 PAD Class

The PAD class (Presentation Assimilation Discussion) is a new teaching mode proposed by Professor Xuexin Zhang of Fudan University. The PAD class allocates half of the class time to the teacher's presentation and the other half to students' discussion, but the key idea is to introduce a psychological individualized assimilation link between lecture and discussion. The presentation and

discussion are separated so that students can have one more day in between for self-paced and individualized assimilation, then participate in the discussion after they absorb the lecture content [13]. The PAD class emphasizes the individualized assimilation process, combines the advantages of lecture mode and discussion mode, which not only ensures the efficiency of the transfer of knowledge system, but also gives full play to the initiative of the students, and adapts themselves to the needs of the social and economic development of the intelligent era in terms of personalized learning, creative learning, deep learning and improving learning efficiency. Under the current educational background, combined with various new educational technologies, the mode of online and offline mixed PAD class has achieved outstanding results in higher education, especially higher vocational education.

2.6 Analysis on the Reform of Classroom Teaching Mode

The traditional classroom teaching mode with lecture mode as the core can "produce" professional and skilled personnel in batches to meet the needs of social and economic development in the industrialized era. From the post-industrial era to the intelligent era, personal freedom has greatly increased, and social and economic life and other relationships have never been more complicated. Traditional lecture teaching mode must be reformed to promote individualized development and adapt to the needs of the times.

In the past century, the four classical learning theories, behaviorism, cognitivism, constructivism, and humanism, developed by educational psychology [14], have great theoretical significance for the reform of education and teaching. Among them, the principle of "student-centered" emphasized by humanism and constructivism, the principle of "active learning cooperative learning" emphasized by constructivism and cognitivism, and the principle of "behavioral process" emphasized by both cognitivism and behaviorism have become the theoretical basis of the new classroom teaching reform mode of flipped the classroom and PAD class.

The application of intelligent technology and modern information technology provides strong technical support for the new teaching mode such as flipped classrooms and PAD classes, enabling them to be implemented. In addition, considering the limitations of "student-centered" humanism and constructivism learning theory, in the specific teaching practice, it is necessary to combine a variety of teaching modes organically, according to the different students' situations and the different teaching environments, especially the unique characteristics of higher vocational teaching, and to achieve the teaching goal through the use of online and offline hybrid teaching with complementary advantages.

3 Practice and Exploration of Reform of Classroom Teaching Mode of a Computer Course in Higher Vocational Colleges

3.1 Teaching Goals and Current Situation

Teaching Goals: The "Bilingual C Programming" is the first major core basic course of Software Technology and other majors of Guangzhou International Economic College (GZIEC). Its goal is to enable students in the form of bilingual teaching to master the basic ideas and methods of programming, understand Computational Thinking, and know the current use of computer programming advanced technology. Through a complete education mode of teaching and educating students, who are trained to possess professional quality, craftsmanship spirit, and the ability to adapt to the rapid development of computer technology.

Current Teaching Situation: To improve professional competitive advantages, GZIEC has been implementing bilingual teaching since 2013, and breakthroughs have been made in the internationalization of education [15]. In the practice of bilingual teaching of courses for many years, not only the teaching mode of foreign universities based on team cooperation learning, discussion mode, case-based teaching, and PBL teaching is adopted, but also the bilingual teaching mode of a step-by-step and phased teaching is adopted according to the actual situation of higher vocational students [16]. With the support of big data and intelligent cloud teaching platforms such as SCHOLAT[1] academic social network, Mosoteach[2] Cloud Classes, the PAD class and flipped classroom teaching mode, combined with online and offline mixed teaching, can better solve the serious problems of higher-order cognition and autonomous learning of higher vocational students.

3.2 Analysis of Student Learning

With the popularization of higher education, the cancellation of admission stage of private higher vocational and multiple parallel voluntary reforms in the college entrance examination admission policy, the enrollment performance of students in private vocational colleges have dropped sharply, their learning ability is weak, and there are serious learning problems as follows.

(1) *Weak learning ability and a strong sense of learning frustration.* They have suffered serious setbacks generally in previous studies, lack self-confidence in learning, and are more likely to give up when encountering difficulties, and are prone to inferiority complex.
(2) *The learning goal is not clear.* They have poor self-control, lack of motivation to learn, and lack of initiative.

[1] https://www.scholat.com/.
[2] https://www.mosoteach.cn/.

(3) *The practical ability of higher vocational students is stronger than theoretical learning ability.* Their learning foundation is weak, and they are more willing to conduct practical operations and exploration practices.

3.3 Curriculum Teaching Design Plan

Innovative Application of Bilingual Education Pyramid Theory. (see Fig. 1) In the reform of bilingual teaching, the contents of thought, moral character, and culture are organically integrated into the teaching session of the curriculum, and a complete education mode of "curriculum thinking and political" is constructed to cultivate students with humanistic qualities, craftsmanship, and the concept of the rule of law.

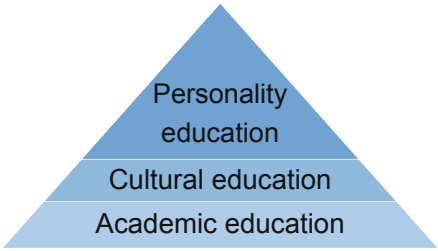

Fig. 1. Bilingual education pyramid.

Distribute Teaching Resources and Organize Teaching Activities. To adapt to the characteristics of individualized and ubiquitous learning of students in the intelligent era, and to meet the needs of extracurricular learning in the flipped classroom and PAD class teaching mode, there are distributed more than 100 micro-class videos and other teaching resources and organized more than 100 teaching activities.

Professional Vocabulary and Mind Maps. To apply and integrate international learning resources [17], and integrate international vocational education certification standards into the training of professional talents, the course is taught following Global Learning and Assessment Development Center (GLAD) international standard for computer professional English vocabulary Professional Vocabulary Quotient Credential (PVQC) [18], and urge students to master the professional keywords through weekly tests vocabulary. At the same time, to enable students to build a complete knowledge system of the course, mind maps of the whole course and each chapter are provided.

Classroom Teaching Mode. The main classroom teaching modes are flipped classrooms and PAD class, while exercise class is based on the discussion mode and the PBL teaching mode of teamwork learning.

Course Teaching Platform. In the early stage of the course, the flipped classroom teaching mode was implemented mainly with the help of the Mosoteach Cloud Classes teaching platform, and then the PAD class teaching mode was implemented with the help of the SCHOLAT course platform.

3.4 Practice of Flipped Classroom Teaching Mode

The application of the flipped classroom mode based on mobile learning in computer teaching in higher vocational colleges is of great significance. This will not only realize the continuous innovation of educational content but also facilitate teachers to demonstrate various new knowledge and skills in the computer field. The learning links after adopting the flipped classroom teaching mode are as follows:

Pre-class: Teachers use the guide plan (learning task list) to guide students to use learning resources to realize ubiquitous autonomous learning. Teachers are the designers and instructors of learning, and students are the main body of self-study, according to the need to repeatedly watch video resources to solve learning difficulties and check their mastery degree through the self-test system.

In Class: The focus of the class is transformed into the innovative mode of knowledge internalization. Teachers use the methods of "problem guidance, project discussion, teamwork, presentation and evaluation" to help students internalize their knowledge and expand their abilities.

Post-class: Students complete programming assignments, improve their programming skills and demonstrate the results of individual or team cooperative learning in exercise sessions.

Using the flipped classroom teaching mode, good results have been achieved in the first half of the semester. But there are also prominent problems:

(1) *The student's pre-class tasks could not be completed on time.* Students in private higher vocational colleges have weaker learning abilities and poor self-learning abilities. At the beginning of college, they were motivated and motivated to study. However, with the increasing difficulty of the curriculum, learning enthusiasm decreased, more than half of the students were unable to complete the pre-class guided learning task list on time, which made the flipped classroom teaching mode impossible to implement as planned, and the teaching effect was greatly reduced.
(2) *Mosoteach Cloud Classes teaching platform has no teaching team cooperation function.* As the leader of the intelligent cloud teaching platform, Mosoteach Cloud Class provides many methods that are conducive to the development of modern teaching modes, but it cannot realize the function of the teaching team, which limits the use of basic courses in higher vocational education.

3.5 Practice of PAD Class Teaching Mode

To solve the problem existing in the flipping classrooms, the PAD class teaching mode and the SCHOLAT course platform are adopted in the later stage and subsequent semesters.

In the teaching philosophy, the PAD class teaching mode advocates teaching first and then learning, while the flipped classroom advocates first learning and then teaching. In this regard, the two teaching modes are completely opposite. When the enthusiasm of higher vocational students is poor and unable to complete the pre-class learning tasks, the advantage of the presentation of lecture teaching mode in the PAD class is extremely prominent. The learning links after adopting the PAD class teaching mode are as follows:

Presentation: The teacher first conducts refined lectures and builds the curriculum knowledge framework through sufficient but not excessive guidance, but intentionally is not detailed, not thorough, and incomplete, leaving room for students thinking after class.

Assimilation: Students are required to think independently, understand personally, and assimilate knowledge. Teachers assign homework, guide, and supervise students to review after class, ensure that students understand the basic content, and prepare for group interaction and discussion.

Discussion: Student groups discuss their own problems, and through this process, solve low-level problems, discover, and condense high-level problems. Then through the teacher to answer questions, they solve high-level problems.

The application of online and offline mixed PAD class teaching mode has solved the problems in the implementation of the flipped classrooms and achieved good results. In addition, the homework adopted in the PAD class teaching mode not only includes the knowledge summary of the learning content, but also the traditional programming exercises and reflective assignment. In addition, the PAD class teaching mode strengthens the process evaluation, does not correct the right or wrong of the usual homework, does not look at the content carefully, and emphasizes unique thinking, and encourages innovation. On the SCHOLAT course platform to support the teaching team, it is easier to realize the process evaluation of teaching.

4 Evaluation and Analysis of Teaching Mode Reform

4.1 Evaluation Method of Course Teaching Mode

With the help of an intelligent cloud platform, we implement the flipped classroom and PAD class teaching mode, and through the application of big data technology, collect, classify, clean and analyze the teaching behavior data of teachers and the learning behavior data of students in the teaching process, realize the evaluation of curriculum and teaching resources, the analysis of the course learning behavior (online use) and learning effect, and improve the quality of teaching. To make up for the lack of a small amount of curriculum data in the initial stage of implementation, we conduct a simple questionnaire survey on the teaching class at the end of each semester. Students answer the questionnaire online through WeChat, and the effective questionnaire reaches 100%.

4.2 Evaluation Results and Analysis

Participation in Teaching Activities and Attendance. From the participation percentage of teaching activities shown in Fig 2, it can be seen that students' participation in various types of learning activities organized by teachers is relatively high, of which attendance (Sign-in activities) percentage averages 98%, participation in self-test activities reaches 83%, and students complete homework on-time percentage for 86%, indicating that flipped classroom and PAD class teaching mode mobilized students' enthusiasm for learning. In particular, the course attendance percentage shown in Fig 3, shows that even the lowest attendance percentage reached 91%, which is extremely difficult for private higher vocational students with a weak foundation, low learning enthusiasm, and lack of motivation to learn.

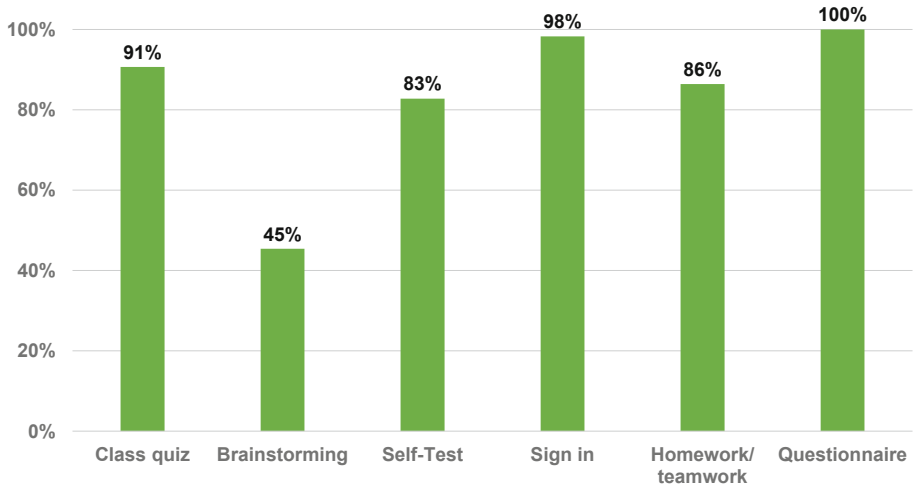

Fig. 2. Teaching activity participation percentage.

Evaluation of the Learning Process of All Students. It can be seen from the way in which all students obtain learning experience points in Fig. 4, that the maximum experience points percentage 62% is online learning, i.e. total experience points of learning online teaching resources for whole students reaches 17,074, considering that students only get 1 experience point for each teaching resource (such as mind map) after class, and learning a teaching video only obtains 2 experience points, so this result shows that students' autonomous and

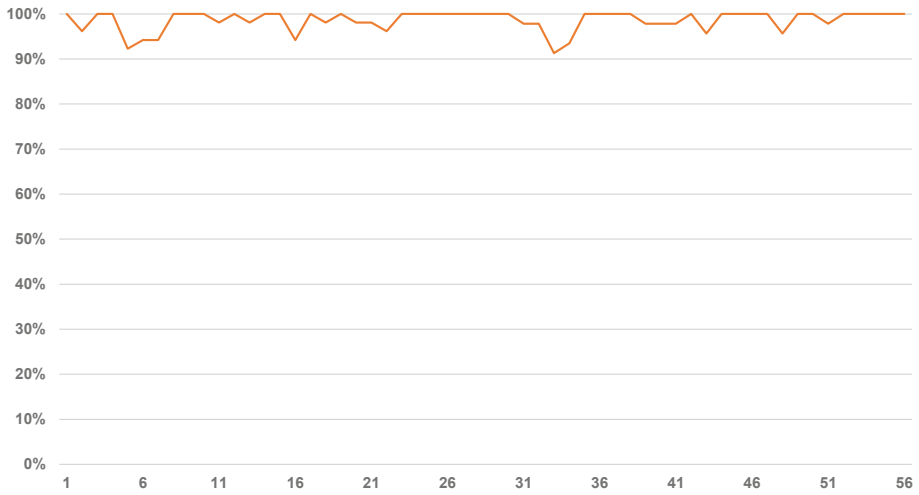

Fig. 3. Teaching activity participation percentage.

ubiquitous learning has achieved remarkable results. In addition, the total experience points obtained by students' attendance, participation in teaching activities, and completion of homework accounted for 38%, indicating that students have a high degree of participation in various teaching links and have formed a habit of active learning.

Analysis of Individual Student Learning. Figure 5 is a radar chart of the analysis of individual student learning.

The data series are defined as follows:

Best: The student with the most experience points among all students.

Excellent: The student with the average experience points of all students whose experience points exceeds 80% of the best student experience points.

Average: The average experience points of all students.

Worst: The student with the least experience points among all students.

From the analysis of the radar chart, the best students perform well in the three process evaluation dimensions of homework/teamwork, self-test, and brainstorming, setting an example for other students. However, the worst students have a large gap in these three process evaluation dimensions, and teachers can conduct targeted attribution analysis based on this to help them solve learning difficulties.

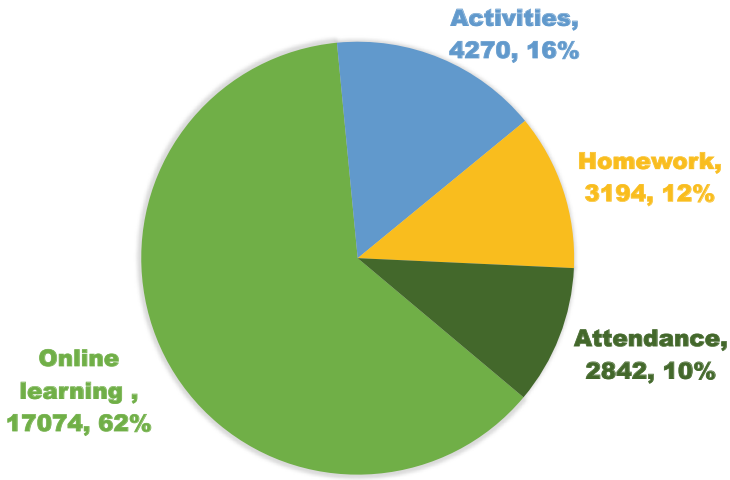

Fig. 4. The way all students obtain learning experience points.

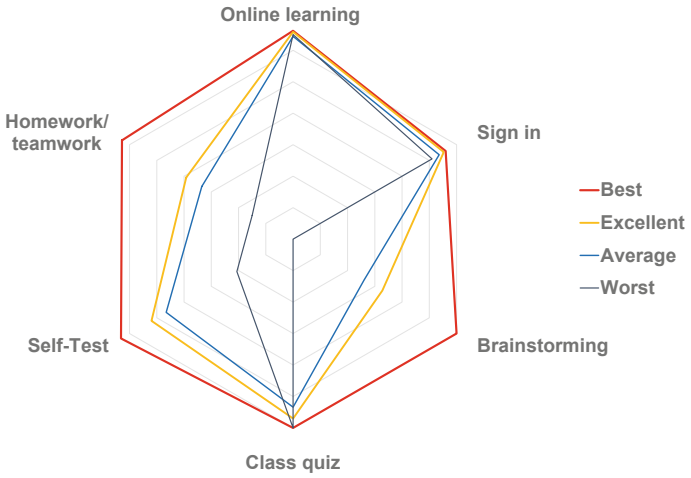

Fig. 5. Evaluation dimensions analysis of individual student learning.

Simple Analysis of Questionnaire Survey Results. From the results of the teaching satisfaction questionnaire in Table 1, the following conclusions can be drawn:

Table 1. Teaching satisfaction survey results.

Teaching satisfaction item	Very satisfied	Satisfied	General	Less satisfied	Very dissatisfied
Flipped classroom	58.7%	32.6%	8.7%	–	–
PAD class	58.5%	37.8%	3.8%	–	–
Evaluate for teacher	70.4%	27.7%	1.9%	–	–
2018 Student self-evaluation	5.7%	26.4%	62.3%	5.7%	–
2019 Student self-evaluation	8.3%	33.3%	41.7%	14.6%	2.1%
2020 Student self-evaluation	3.5%	54.4%	40.4%	1.8%	–

Flipped Classroom Teaching Mode: There are 91.3% (=58.7%-Very satisfied + 32.6%-Satisfied) of students who think this mode is helpful to students' learning, and 58.7% of them think it is very helpful.

PAD Class Teaching Mode: up to 96.3% (=58.5%-Very satisfied + 37.8%-Satisfied) of students think this mode is helpful to students' learning, and 58.5% of them think it is very helpful. This shows that the use of the PAD class teaching mode has mobilized students' learning enthusiasm and has been unanimously recognized by students.

Comprehensive Satisfaction of Teachers' Teaching: The survey shows that up to 98.1% (=70.4%-Very satisfied + 27.7%-Satisfied) of students are satisfied with the teachers' teaching, and there are no students who are dissatisfied with the teachers' teaching, indicating that the teachers' hard work in teaching reform has been recognized by the students.

Self-evaluation of Students' Learning Situation: Based on the self-evaluation of students in the three grades from 2018 to 2020, the satisfaction of students' self-evaluation has increased year by year for three consecutive years from 32.1% (=5.7%-Very satisfied + 26.4%-Satisfied, similarly hereinafter) in 2018 to 41.6% (=8.3% + 33.3%) in 2019, and 57.9% (=3.5% + 54.4%) in 2020, indicating that students' learning initiative, and sense of acquisition have been further enhanced. This result is not easy to achieve, because nearly 60% of the students' admission scores are only about 16 points in the converted 100 point system, and over 80% of students' admission scores of English courses are less than 40 points. This also shows that under the guidance of teachers' reform of teaching mode, students' autonomous learning ability has made significant progress, and meets the learning requirements of the intelligent era. The course teaching has reached the goal of teaching with improvement, learning with achievement, teaching and learning mutually beneficial.

4.3 Summary

The use of the teaching mode reform of PAD class and flipped classroom enables teachers and students to communicate effectively, improves students' enthusiasm for independent learning and ubiquitous learning, not only enhances students' ability to actually program, independent learning, summary, but also improves students' ability to think independently, pioneering and innovative and presentation, effectively improves the classroom teaching effect, promotes the development of students' personal comprehensive quality, and truly realizes the cultivation of knowledge, ability, and quality.

5 Conclusion and Limitation

In response to the need for the cultivation of high-end talents in higher vocational education in the intelligent era, this study analyzes the characteristics of various teaching modes in higher vocational curriculum teaching and discusses combined with various new educational technologies, the teaching mode of online and offline mixed flipped classroom and PAD class. After the implementation of the "Bilingual C Programming" classroom, the results of empirical research show that the students who adopt the flipped classroom and the PAD class teaching mode show good learning results and stronger learning motivation. In particular, it was found that, with the support of intelligent cloud platforms such as the SCHOLAT Network, the emphasis on ability training and teacher-student interaction, combined with online and offline mixed teaching of the PAD class teaching mode, can better adapt to the current level of higher vocational students' poor foundation, lack of self-confidence status, and realize the goal of teaching with improvement, learning with achievement, teaching and learning mutually beneficial.

Nevertheless, this study has the following limitations. On the one hand, this research was only conducted in three classes of three grades of "Software Technology" major, with a small sample size. On the other hand, the scale design and analysis of the questionnaire survey are relatively simplified, and an effective and in-depth analysis of reliability, validity, and correlation has not been implemented. These are the directions for further in-depth study in the future, but the conclusions drawn from the research are general and can provide references for further teaching mode implementation.

Acknowledgments. Our work is supported by the National Natural Science Foundation of China (No. U1811263), University Characteristic Innovation Natural Science Project from the Department of Education of Guangdong Province (No .2021KTSCX341 and No. 2020KTSCX375), and the Teaching Reform Project from Guangzhou International Economic College (No. SWZL202109, and No. SWZL202108).

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