Journal of Contemporary Educational Research

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Diversified Teaching Method in Basic Piano Course Instruction for Higher Education Teachers

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Abstract: Diversified teaching plays an important role in the sustainable development of China's basic piano course instruction for higher education teachers. A diversified curriculum system should be designed to promote the development of each student, and efforts should be made to cultivate high-quality talents who can adapt to the various needs of the society as well as to promote the reform and development of basic piano course instruction for higher education teachers. The aim of this study was to explore the teaching of basic piano course for higher education teachers based on the diversified teaching method. The teaching methods use for basic piano course were analyzed in this study, and two research methods were used to carry out the present study so as to effectively improve the operation of the diversified teaching method. Through a survey of the current situation of piano instruction in two higher education faculties, we can see that the teaching of basic piano course in higher education is still dominated by the traditional teaching method although the majority of students preferred the diversified teaching method.

Keywords: Diversified teaching method; Piano teacher; Higher education; Foundation course; Music curriculum

Online publication: March 9, 2023

1. Introduction

Music education students should not only be proficient in the theoretical aspect of music performance, teaching, and practical knowledge, but also have strong vocal and instrumental skills for performance, music appreciation and aesthetic skills, knowledge of various types of works from all periods, and basic creativity skills [1,2]. In addition to these, the ability to handle a variety of events and competitions, along with some research skills, is required. Vocal lessons, piano lessons, and choral lessons, all require a solid foundation in piano. Additionally, improvisation, sight-reading, ear training, and music composition are all closely linked to piano [3,4]. A good foundation in piano is a great addition to a music educator's repertoire [5]. The task of a basic piano course in music education in tertiary institutions is challenging, and if it is taught through the traditional "group lesson" method, students with poor foundation in piano often tend to give up in the process of learning. This has led to a need for teachers to revamp old piano courses and explore new and diverse teaching methods for piano instruction [6].

Trueman's research aimed to develop a glove with an integrated haptic interface to help new piano players learn and to allow them to play without a piano. In his study, analysis, design, development, implementation, and evaluation of the method were carried out. During the analysis phase, he identified and analyzed the needs of students and problems faced by them. During the design phase, he analyzed the practices that were commonly used to solve these problems and decided that a tactile glove might be suitable for solving the existing problems. During the development phase, he evaluated the development and format

of the product. The participants included in the study were requested to use the tactile glove over a period of time. Thereafter, their opinions of the product were recorded via video camera. Upon analysis of the recordings, it was found that the second version of the haptic glove improved the participants' level of musical recall [7]. In another study, Podder presented a visualization system course for distance piano learning, which involved the use of 5G network. In the course, the telepresenter provided a range of ways for adults to engage in online learning preparation. The idea of online communication in a network of instructors and learners was extraordinary. When considering training-based or executive-based courses, learning systems may exhibit poor sound quality, and the sound may be delayed due to poor network connection. Online learning offers adaptability and internationalization as well as the opportunity to interact with different individuals and bring them together in an online learning platform. The installation of remote sensors suggests that users of 5G network for distance learning view it from a common-sense perspective. Furthermore, there is a need to advance online piano training in guided practice [8]. Pervez has proposed a diverse range of teaching methods, combining heuristics, case studies, and participatory and mini-classroom teaching, based on the characteristics of students for traditional classroom teaching and provided concrete examples of the implementation of each teaching method. Through a combined analysis of questionnaires, student evaluations, and examination results, the applicability and effectiveness of the diversified teaching method in classroom teaching for environmental courses have been verified. The results of his research may provide some reference to the study of classroom teaching methods in environmental courses and related fields [9]. As the basis for future teacher training, teacher training colleges should keep up with the development of the times, carry out curriculum reform, and train teachers to adapt to the needs of the times and social development.

In the present study, both the questionnaire survey method and the literature analysis method were used to obtain two perspectives for in-depth research. First, through literature search, a large number of literature facts related to the diversified teaching method were comprehensively and accurately grasped; the advantages and the problems that arose in the implementation of basic piano course for higher education teachers were analyzed so as to explore the basic concept and teaching principles of the diversified teaching method. The findings were then validated at a city teacher training university and art college. Further explorations of the new problems identified are required.

2. Use of pluralistic pedagogy in basic piano course for higher education teachers

2.1. Basic piano theory course

Piano lessons are the core subject of music major in normal universities, and they play an important role in music education in normal universities (piano learning is diversified and comprehensive) [10,11]. As the piano is the main instrument for music teaching in middle schools, it is even more difficult for music teachers who do not play the piano to obtain qualifications for high-school music instruction. Therefore, high school students should learn the piano through piano lessons so as to prepare for future music education.

The basic piano theory course and practical course in normal universities are two aspects of piano education; that is to say, the piano course in normal universities consists of a basic theory course and a practical course. The piano practical course is a course that focuses on operating the piano, and its teaching contents mainly include learning to play the piano and practicing music. Students are trained on piano operation skills by performing basic exercises, namely finger independence, hand coordination, tactile sensitivity, *etc*., Students are taught various piano skills and trained to play the piano. Therefore, the piano practical course basically functions as a practical workshop [14].

2.2. Basic idea of the diversified teaching method in basic piano course for higher education teachers

The diversified and open teaching method of piano teaching in higher education forms a structural teaching

mode based on the above reasons. The first is the establishment of plurality of subject content in current piano pedagogy, *i.e.*, plurality of teaching materials and teaching content. In this way, it empathizes with the lives of normal students and meets their practical needs. The focus of teaching remains, of course, on the learning and training of pedagogical theory and teaching skills.

Second, the current piano instruction, as a book-based form of teaching organization, is too rigid to build openness. Outstanding piano teachers should be invited to higher education institutions so that they can share their growth experiences with trainee teachers.

The diversified and open teaching method of piano teaching in higher education is not a 45-minute classroom teaching lesson, but a holistic teaching method for piano teaching courses. Therefore, in the context of operation, different micro-teaching methods should be adopted based on specific situations in order to achieve the best teaching effect for each teaching unit, each lesson, and each teaching activity.

2.3. Teaching principles of the diversified teaching method of basic piano course for higher education teachers

(1) Student development needs

In the teaching process under the open and diversified teaching method, the principle of meeting the development needs of teacher-training students' vocational guidance is always adhered to. In the selection of teaching contents, teaching methods, and vocational training methods, the career development needs of teacher-training students are fully respected, and extensive opportunities and space are provided for these students to participate in teaching practice both inside and outside schools. In accordance with the theory of multiple intelligences, they are enabled to devote their valuable time to developing relevant vocational skills.

(2) Making full use of modern educational technology

When presenting outstanding examples in classrooms and conducting micro-teaching skill training, modern educational technology should be used. Video cameras and tape recorders can be used to record live teaching activities and lectures; placement reports should also be utilized to continually improve and enhance teaching skills, practical teaching skills, and teaching innovation through reproduction. In addition, multimedia classrooms can be utilized to produce and present teaching materials, and there should be some efforts to improve the ability of students to use modern educational technology.

3. Questionnaire

In order to have a more comprehensive understanding of the current situation of basic piano course instruction, a survey was conducted in two music faculties (departments) in a city between Liaoning Normal University and Dalian University, during which questionnaires were distributed to the teachers and students of each faculty. The questionnaires were distributed to 100 students (sophomores, juniors, and seniors) from one of the two music faculties, 90 of which were valid, and 10 teachers, in which all were valid, as well as 150 students (sophomores, juniors, and seniors) from the other music faculty, 130 of which were valid, and 5 teachers, in which all were valid. The t-test formula was used in this study, as shown below.

$$t = \frac{\overline{X} - \mu}{\frac{\sigma X}{\sqrt{n}}} \tag{1}$$

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \tag{2}$$

Equation (1) is a one-sample t-test, while equation (2) is a two-sample t-test; S is the sample standard deviation, and n is the sample size.

The results of the survey are presented in tabular form and analyzed in relation to the interviews and teaching observation in terms of diversified methods of piano teaching, curriculum, and the use of modern teaching technology.

4. Analysis of the current situation

In the survey of frequently used teaching method and students' preferred teaching method, passive acceptance received the highest recognition as a frequently used teaching method, as shown in **Table 1**. Passive acceptance is a traditional teaching method, in which teachers teach and students learn. If this traditional teaching method is used, it will not be able to meet the needs and development of the new teaching philosophy. The second in line is demonstration-imitation, which is essential in piano teaching. In this method, through accurate and skillful explanations and demonstrations, guidance, and inspiration by the teachers, students can intuitively learn the basic movements and essentials of piano playing and gain a perceptual understanding that they have risen to a certain level of rationality for learning. In this way, students can better grasp the playing style and skills of a piece. In terms of the teaching methods used, all four teaching methods, individually, made up less than half of the questionnaires filled, suggesting that the students think that the teaching methods used in piano teaching are relatively homogeneous and the diversified and experiential teaching methods are less frequently used; however, 128 students showed interest in the diversified teaching method, as shown in **Figure 1**.

Table 1. Number of students

Teaching method	Frequently used teaching method	Preferred teaching method
Passive acceptance	102	30
Demonstration-imitation	51	7
Experiential	28	55
Diversified	39	128

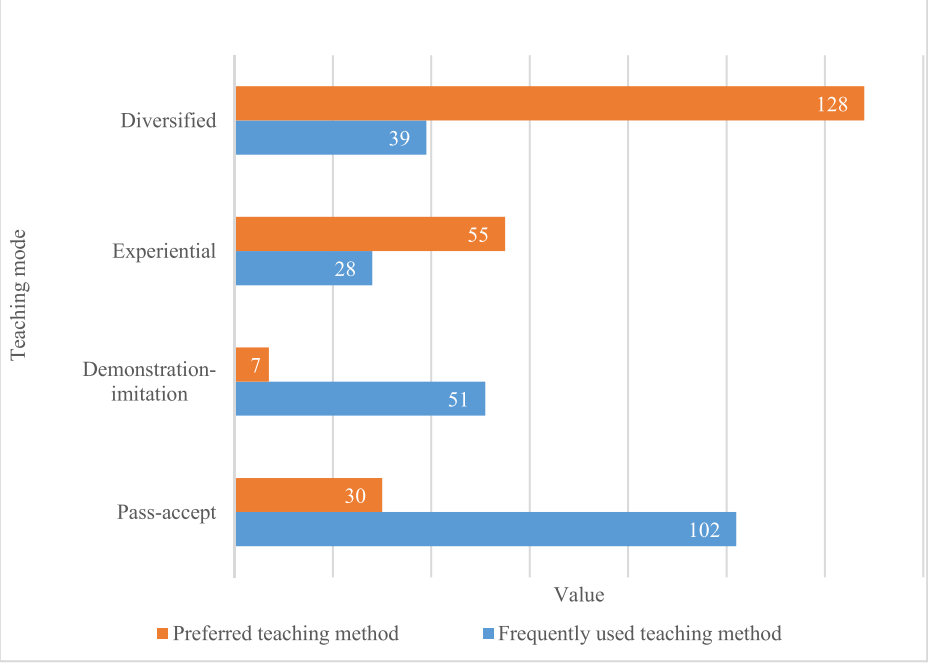

Figure 1. Students' views on teaching methods

In the student questionnaire, 34.5% of students felt that the current piano course in higher education was dull and lacked diversity, as shown in **Figure 2**. The increase in course content requires an increase in lesson time; a reasonable arrangement of sufficient lesson time to meet the learning needs of students should not be overlooked. The lack of practicality of piano teaching materials, as perceived by 24% of students, is mainly manifested in the inability to adapt to the developmental needs of students under the new curriculum concept and is also one of the reasons for the singularity of students' choice of repertoire, as shown in **Figure 2**.

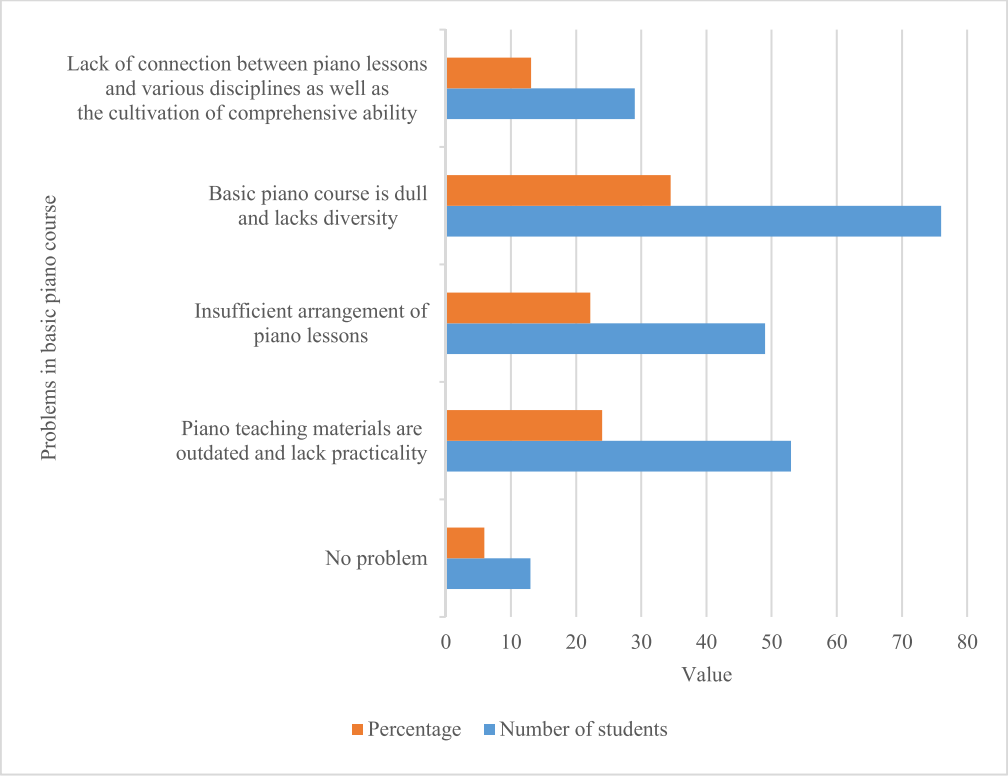

Figure 2. Problems in basic piano course

Modern educational technology has greatly enriched classroom teaching in terms of the application of multimedia. It has increased the interest in teaching and learning and is conducive to stimulating students' interest in learning. Moreover, it has increased the amount of information in teaching and learning and is conducive to developing students' musical and cultural horizons. Also, it has promoted the reform of music teaching and improved its efficiency. We should give full play to its advantages and role in teaching. However, the reality is not quite as it should be; the use of multimedia in piano teaching in higher education needs to be improved and developed. According to the survey done under the present study, there are only a few multimedia piano teaching equipment in the faculty, and it is easy to pinpoint other problems that are more prominent, such as the lack of understanding, operation, and maintenance of equipment among teachers, which may result in idle equipment or even damage to the equipment due to improper use and maintenance.

5. Conclusions

Piano lessons in higher education are technical subjects. The enrichment of piano lessons and the development of the teaching system will be an impetus for the improvement and enhancement of music education. In terms of how to achieve this goal, diversified teaching, a reasonable teaching curriculum, and the training of students who are competent to take on the role of qualified music teachers in today's society

are the keys to the problems that need to be addressed in the teaching of piano lessons at present. The design of the diversified teaching method in this paper offers an alternative or reference to a new teaching method for the reform of teaching materials for piano pedagogy in higher education and the teaching of piano teachers in higher education. However, this method does not cover all the aspects of piano instruction in higher education. The research and application of piano teaching methods for higher education teachers require constant exploration, updating, and flexible use by piano educators.

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Disclosure statement

The author declares no conflict of interest.

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Research on the Construction of a "New Ecology" of University Catering

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Abstract: With the goal of establishing morality and nurturing people, university catering is thought to be one of the key components in the construction of "double first class" universities, which supports and leads the reform of education modernization. In this study, the common problems in the university catering were analyzed, and research was done through questionnaires and interviews. This study takes Beijing colleges and universities as the research object to understand the needs of students and teachers and aims to build a "new ecology" of university catering, and vigorously promote the construction of green campuses.

Keywords: University catering; Education modernization; New ecology; Green campus

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1. Introduction

In recent years, in response to a series of problems, such as the quality, quantity, type and price of dishes, tableware hygiene, environmental hygiene, sales specifications, dining order, miscalculation, waste, and so on, which were reported by teachers and students in colleges and universities, the Ministry of Education in 2020 issued policies to eliminate food waste. These policies emphasized on the enforcement of related laws and taking effective measures and establishing long-term solutions to eliminate waste. We should also popularize and provide education on cultivating the habit of saving, so as to create a society that loves saving and hates wasting.

On April 29, 2021, the Law of the People's Republic of China on Combating Food Waste was passed in the 28th meeting of the Standing Committee of the 13th National People's Congress [1], which turns food wastage from a moral issue into a legal issue. Article 5 of the Anti-food Waste Law clearly puts forward the need to use information technology to help fight against food waste: catering service operators can utilize information technology to analyze the food demand and scientifically manage food procurement, transportation, storage, processing, and many more by building central kitchen, distribution center, or by other measures. In this way, the satisfaction towards the food served will be improved, and the reform of university catering can be realized. With that, teachers and students will be motivated to "take charge of their plates," which will drive the innovative development of the catering industry.

2. Problem analysis

In March 2022, the author distributed online questionnaires and conducted online interviews with students from 20 universities, including Peking University, Tsinghua University, Renmin University of China, Beijing University of Science and Technology, China University of Geosciences (Beijing), and North China

Electric Power University. 23,268 students filled out in the questionnaire, and 21479 valid questionnaires were collected, with a recovery rate of 92.31%. Undergraduate students accounted for 72%, while others accounted for 28%. The content of this questionnaire is based on the renewal of university catering, and 30 questions were set up, which were divided into five parts: the understanding of the new ecology, the new intelligent platforms and standards.

According to the data collected through the questionnaires and interviews, more than 90% of the students showed great interest in smart catering. Furthermore, they were very willing to talk about the problems of their schools' catering and were very open to the renewal of university catering. They were also eager to reconstruct the catering system in their own schools. However, there are a few problems in the renewal of university catering.

2.1. The infrastructure is lacking, and an intelligent platform needs to be built

Infrastructure is the carrier of the construction of the "new ecology" the material basis for the development of a green campus. With the increase of enrollment in colleges and universities, the investment in hardware has increased, but the speed of construction could not keep up with the students' needs. According to the data, 71.1% of students' schools do not have intelligent settlement systems. 13% of the students' schools have intelligent settlement systems, but there are no new standards, but they need to be further developed.

2.2. The education on food wastage is lacking

In the catering management, we should take honesty, openness, and communication as the basic principles to implement intelligent management supported by big data as well as pay attention to the democratic and educational role of management. Students are not only the forerunners of the rule of law in China, but also the impetus for active participation [2]. According to the data analysis, 68% of the students said that they had a bad appetite and could not eat, so they had to give up, while 38% of the students thought that they or their classmates have a lack of understanding of the food culture, and waste is inevitable. Therefore, it is necessary to adopt new ideas and methods to correct uncivilized behavior and bad habits. Besides, it is also important to initiate the development of smart catering and implement incentives such as a point reward system for meals.

2.3. Unfavorable dining behavior and lack of personal culture

Dining behavior is a part of food culture, which can fully display the comprehensive quality of students. However, the data shows that 97.2% of the respondents' schools have not held any themed activities around food waste. In fact, if the schools were to organize these kinds of activities, the respondents would actively participate in them and actively promote food culture. Personal culture is the basis of food culture, which relates to students' values, pursuits, dining behavior, and overall image. Organizational behavior and culture also emphasize on the implementation of specific behavior activities [3].

2.4. Lack of ecological awareness

According to the survey data, due to the poor ecological education, while college students have some sense of ecological responsibility, they generally have a poor understanding of ecological civilization and ecological rule of law. They are also unaware of overconsumption, such as luxury consumption and consumption comparison, and lack sufficient understanding of the practical measures to build a socialist eco-civilization [4]. Campus culture and professional education complement each other. Without the promotion of campus culture, the effect of education on ecological civilization will be greatly reduced.

2.5. Lack of institutional supervision

Some prominent problems in the construction of green campus are mostly related to the imperfection of the catering ecological civilization system. There is still a lack of effective top-level organizational structure and scientific planning on how to implement the concept of ecological civilization and solve the problem of the lagging institutional construction. The division of labor and coordination, resource integration, institutional system among different departments of colleges and universities needs to be further improved. [5]

2.6. Low merchant standards

High-quality catering enterprises that are honest, have good performance, and are law-abiding and professional should be selected using scientific methods during canteen outsourcing [6]. The catering center should supervise and train the outsourcing units in accordance with the relevant national policies and regulations, industry standards, and the terms of the agreement signed between the school and catering enterprises, so as to ensure continuous improvement and optimization, so as to achieve good risk management.

In short, food quality, personnel quality, family income, conservation awareness, environmental education, reward and punishment mechanism, and comprehensive evaluation reflected in the survey data are the focus of the constructing the new ecology of university catering. These focuses directly reflect the existence of certain problems in the operation mode, intelligent management, energy conservation and environmental education, and "three complete education" of catering. These problems are all included in the scope of the education of all members of universities. Therefore, this makes the construction of a new ecology of university catering is necessary.

3. Construction of a new ecology

Science and technology empowerment and ecological innovation are the new models of the current social development. The situation of various industries is also progressing along with the social advancement, and university catering is also one of them. It will be an inevitable trend for colleges and universities to focus on the overall chain, strengthen scientific and technological innovation, constantly explore the use of new technologies, new processes, and new equipment, and to integrate information technology, the Internet of Things, artificial intelligence into canteen management, and so as to renew the college catering system (**Figure 1**).

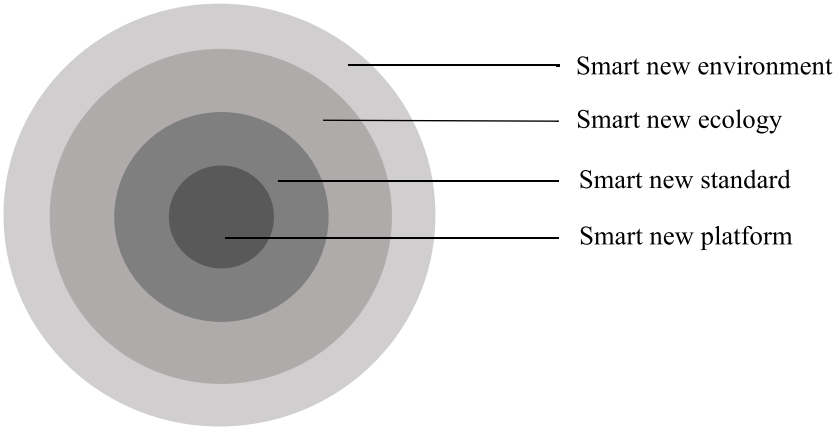

Figure 1. The new structure of university catering

3.1. Building a new intelligent platform based on big data

The construction of smart canteen should be supported by big data and focus should be on building a big data platform for school catering. At present, the smart canteen has moved from the 1.0 era of replacing part of human labor with intelligent equipment and improving work efficiency to the 2.0 era of realizing the big data integration of the whole catering chain, assisting managers to make better decisions, and is moving towards the 3.0 era of "taking charge of our own plates."

In some universities in Beijing, there were significant changes brought by the construction and upgrading of the smart canteen from the dining style of teachers and students to their dining experience. The use of intelligent settlement desk (1.0 era) has significantly saved time and labor. The function of the smart restaurant is further expanded and upgraded (2.0 era). The basic data of each dish is recorded in the background management system. Through data analysis, customer preferences can be understood. Leftover dishes are eliminated, while new ones are constantly introduced. This would improve the overall quality of canteen dishes and reduce food waste. In the 3.0 era, we will truly realize big data utilization and build a long-term mechanism to reduce food and beverage consumption. On the one hand, in the smart canteen, basic information such as the types and flavors of dishes in the school cafeterias and restaurants can be input into the system as the basis of data analysis; besides, personal dining and consumption habits, consumption records, and food sales data of teachers and students will be imported into the system. Through big data, it is possible to identify dishes that are popular. Based on data analysis, a report can be created to help the canteen achieve high-quality supply and further promote the reduction of food waste.

Of course, the value of data is way more than that. When big data meets cloud computing, the smart canteen can even become a smart canteen for every teacher and student, hence achieving "customization." The information system accurately records the consumption behavior of teachers and students. Through the comprehensive analysis of their consumption habits, taste, quantity, time, price, evaluation, and other preferences, a unique personal dining data report can be created for each teacher and student. In this way a customized catering service can be provided for each teacher and student, and healthy eating can be promoted, thus comprehensively improving the quality of catering services.

3.2. Develop a new form of intelligence through catering management

In the research of smart catering in universities, the unified standard of smart catering management platform is indispensable. The Code for the Construction of Intelligent Canteens in Colleges and Universities has entered the stage of soliciting opinions, which will further promote the work of curbing food waste and make college canteens become an example for reducing food waste.

At present, all enterprises have their own ecosphere, such as Xiaomi Ecosphere and Huawei Ecosphere. The university catering industry should also have such a smart ecosphere to make this ecosphere a standard. It is not an independent application, but the underlying system that carries the application. A standardized intelligent catering management platform will open up all links from raw material procurement, warehouse storage, distribution, production, and processing, finished product sales, to satisfaction evaluation, and realize the efficient management of the whole chain. In this way the scientific decision-making and service efficiency and the management of campus catering can be improved. As a result, a resource-saving intelligent canteen can be constructed. The food-saving system and waste reduction at the consumer end helps the construction of a long-term mechanism to combat food and beverage waste on campus.

3.3. Creating a new intelligent ecology with "educating people" as the cornerstone

The intelligent canteen is an important part of the intelligent logistics in colleges and universities. Intelligent canteens should be constructed through intelligent logistics platform. Only by establishing the overall intelligent logistics can the advantages of intelligent canteen be fully demonstrated. It is the main goal of

"educating people" that connects the intelligent logistics. The purpose of logistics in colleges and universities are not only to provide high-quality service and management, but also to educate people. Management, service, or the creation of environmental atmosphere are all important parts of education for the staff.

If the intelligent logistics is based on comprehensive evaluations by students, the data of their behavior can also be included into the system. For example, when a student is eating in the cafeteria, if the system detects that the student has a lot of leftovers, the information will be recorded. In time, if the behavior of wasting does not improve, the student's score will be affected. This will raise their awareness towards the Clean Your Plate Campaign and participate in anti-food waste more consciously.

3.4. Electronic payment opens a new era of wisdom

Digital RMB has the characteristics of "breaking the walls of transaction," high security and credibility, green, low carbon, and high efficiency. It comprehensively links and connects financial flow, information flow, capital flow, logistics, etc., and provides a payment method for all consumption scenarios. Besides, it easily links with different medias such as linking to the campus one-card, making it "one-card +," which provides better privacy and security. The arrival of the era of "big card" will also promote the development of smart canteens from the bottom.

The university campus is a unique platform for digital RMB, which can be organically integrated with the construction of smart campus, and may also produce "spillover effect," in which it can be used outside the campus. Digital RMB will actively promote the construction of smart canteens, smart logistics, smart campus, green campus and zero-carbon campus while bringing about payment reform.

The construction of smart campus in the new era will promote the comprehensive, systematic and profound reform of the education of colleges and universities. In the near future, colleges and universities across the country will gradually enter the era of smart canteen 3.0, which is an era in which various effective resources of the Internet society are integrated with the whole process of campus catering operation. At that time, the smart campus big data platform and the social platform with the goal of educating people will be formed. Off-campus data will be shared to the campus catering system, and resources from netizens will be to the campus catering system, so as to realize the complete transformation from decision-making by humans to decision-making by big data. The needs of teachers and students are identified according to the perfect big data system, and catering services that cannot meet those needs will be eliminated. The preferred food items and catering companies are retained, thus changing the way of dining in campus from "eating whatever that is available" into "having whatever the students like," and fully realize the beautiful vision of "taking charge of their own plates."

With the comprehensive integration of science and technology into the new trend of daily life, the school catering service resources will become more and more intelligent. With the purpose of satisfying the needs of students and teachers, smart university catering integrates advanced technologies such as mobile internet, big data, cloud computing, etc., which will kickstart high-quality catering and build a new campus catering ecosystem.

4. Conclusion

From the comprehensive analysis of the survey results, there are problems of different degrees in the operation mode and the construction of catering culture in colleges and universities. It is hoped that that colleges and universities can rely on big data and eliminate traditional catering, and reconstruct the new ecological framework of catering. Besides, colleges and universities should strive to be people-oriented, traceable, and eliminate waste, achieve harmonious coexistence between human and nature, and lead the innovative development of college catering and the overall catering industry.

Disclosure statement

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Research on the Cultivation of Craftsmanship in Huang Yanpei's Education Thought

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Abstract: Skilled talents are the main support for the strategic development of science and technology in China. The quality of talents is an important guarantee for the transformation and upgrading of national industries. By analyzing and studying Huang Yanpei's thought on vocational education, this paper focuses on the cultivation of students' craftsmanship in vocational schools. First, we analyze the results of previous research and then elaborate on the connotations of Huang Yanpei's education thought and craftsmanship spirit. Lastly, we propose five suggestions for the cultivation of craftsmanship. Our research work carries certain reference value to the study of craftsmanship cultivation in Huang Yanpei's education thought.

Keywords: Cultivation of craftsmanship; Craftsmanship; Teaching; Huang Yanpei's education thought

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1. Introduction

The vigorous development of vocational education is an inevitable requirement for promoting economic and social development and building a strong country in science and technology. In recent decades, vocational education has provided strong talent support for the rapid development of the national economy. With the acceleration of industrial upgrading and economic transformation, the demand for high-level skilled personnel in various industries and the value of vocational education are increasing [1]. With the announcement of the Made in China 2025 Initiative, China has accelerated the transformation from "Made in China" to "Made with Quality" and "Created in China." Meeting the requirements of the changing times and strengthening the cultivation of students' craftsmanship are the missions given to vocational education. However, at present, there are problems, such as lacking follow-ups of concepts, designs of teaching contents, and innovation in collaboration with enterprises, in cultivating students' craftsmanship in vocational schools [2].

A century ago, Huang Yanpei put forward his educational thought, which includes "using hands and brains" and "doing and learning together," pointing out the direction for the development of vocational education in China [3]. The cultivation of craftsmanship is an important element of Huang Yanpei's education thought. In order to ensure the development of vocational education, it is important to explore the value of Huang Yanpei's education thought from the perspective of cultivating craftsmanship [4].

2. Research status

Huang Yanpei's thought on vocational education has been a hotspot in research, especially among vocational education academia, and a large number of studies have been conducted. Chen [5] carried out an in-depth study of Huang Yanpei's education thought in the new era, proposing that the idea of "sanctity of

labor" should be established in vocational education and emphasis should be placed on vocational education and professional ethics education. Yan [6] explored Huang Yanpei's thought on vocational education and its contemporary inspiration. According to Yan, vocational schools should carry forward Huang Yanpei's education thought, cultivate the spirit of craftsmanship, and better serve the society. On the other hand, Liu [7] studied the formation, connotation, and value of Huang Yanpei's education thought in the modern world. He believes that the inheritance of Huang Yanpei's education thought plays a significant role in the development of vocational schools. Wang [8] studied the application of Huang Yanpei's education thought in the new era and argued that vocational schools in the new era should draw on Huang Yanpei's education thought and experience and combine with the modern apprenticeship system to form a training model in which production, learning, and doing are mutually integrated. Cai [9] reflected on Huang Yanpei's education thought in the context of modern apprenticeship. He considers the modern apprenticeship system as a means of implementing the hand-brain system and integrating industry with education. Gao [10] studied the "four directions" of Huang Yanpei's education thought. According to Gao, Huang Yanpei's education thought has far-reaching significance for the healthy development of vocational education in China. Wu [11] studied the inspiration of Huang Yanpei's education thought to the cultivation of craftsmanship. He believes that excellence is the core of craftsmanship spirit and vocational school students must respect their profession. Zhao [12] analyzed the influence of Huang Yanpei's education thought on the professional development model of teachers and proposed several strategies for teacher training based on Huang Yanpei's thought on vocational education. Song [13] and Guo [14] studied the positive correlation between vocational education and socio-economic development, taking Huang Yanpei's thought on "big vocational" education as an example. According to these scholars, this education thought acts as a guideline that enables people to break away from backward thinking and address the disconnections between industry and education in vocational education.

Craftsmanship is an objective need for building a strong country in science and technology. Scholars have carried out a lot of research on cultivating craftsmanship. Gao [15] studied the cultivation path of craftsmanship spirit in modern vocational education, suggesting that teachers should integrate the cultivation in the teaching process and strengthen the shaping of students' professionalism. In addition, Zhang [16] studied the craftsmanship cultivation model in metallurgical higher vocational colleges and proposed the idea of nurturing craftsmanship from four aspects: the state, school, teachers, and students. In another study, Song [17] studied the cultivation path of craftsmanship. According to Song, the cultivation of craftsmanship is an important task, which can be accomplished by relying on the joint efforts of individuals, the society, and the state. Sun [18] studied the path of cultivating craftsmanship spirit in higher vocational schools from the perspective of excellent traditional Chinese culture, arguing that the essence of traditional Chinese culture should be fully drawn in the cultivation of craftsmanship spirit and that teachers should focus on cultivating humanistic feelings and professionalism among students. Bu [19] studied the strategies for cultivating craftsmanship among higher vocational teachers. He believes that higher education teachers should uphold the craftsmanship spirit so as to enable students to experience the craftsmanship spirit through their teaching. Li [20] studied the process of cultivating the craftmanship spirit of labor culture in higher vocational students and argued that school-enterprise synergy must be adhered to in the cultivation of humanistic sentiment among students. Huang [21] conducted a study on the cultivation of craftsmanship in the new era, emphasizing that craftsmanship is an important part of the cultivation of high-quality skilled talents. Meanwhile, Yang [22] analyzed the status quo of cultivating craftsmanship spirit in vocational colleges. According to Yang, craftsmanship should be integrated into the whole teaching process to meet the goals of talent cultivation. Tal [23] studied the role of higher vocational physical education in cultivating craftsmanship and asserted that higher vocational schools should take physical education classroom as an important platform for cultivating craftsmanship.

3. Huang Yanpei's thought and craftsmanship

3.1. Huang Yanpei's thought

Huang Yanpei established the policy of "socialization, scientificization, and civilianization" in running education. According to Huang, the development of vocational education focuses on the needs of society, while the solution to the problems in vocational education depends on scientific methods. His suggestion to solve the problem of civilian livelihood centers on vocational education. Huang Yanpei put forward the principle of "using hands and brains" and "doing and learning together." According to Huang, theory and practice are parallel and equally important. He stressed the importance of both knowledge and skills and put forward the education purpose of making the unemployed employed and those who are employed enjoy their work. His belief was that vocational education should first satisfy individuals in terms of earning a living, and it should then, on this basis, strive to achieve the function of serving the society. Furthermore, he argued that vocational education should adhere to the following fundamental values: "dedication to work and happiness" and "love for country and people." It is important for students to develop the correct concept of personal career and a healthy mind to serve the society.

3.2. Craftsmanship

Craftsmanship represents not only a high-level skill, but also a rigorous, meticulous, dedicated, and responsible work attitude as well as a sense of identity, responsibility, honor, and mission for any profession. Craftsmanship is a form of value orientation and behavior toward a profession, that is, the practitioner's reverence for the profession and the persistent pursuit of excellence and continuous innovation in products and services. Richard Sonnett, a famous American sociologist, once pointed out that craftsmanship is the desire to do things well. It can be said that craftsmanship is the ultimate professionalism that is deeply rooted in the practitioner's inner being. Cultivating craftsmanship is not just a slogan; it should be implemented in vocational education and reflected in the thoughts and actions of every student. In the process of cultivating craftsmanship, higher vocational schools must first clarify the fundamental aspects of craftsmanship so as to cultivate students' craftsmanship personality and shape. It is only by doing so that we can cultivate student' personality and shape great craftsmen. Professional ethics is the heart of craftsmanship. At the level of professional ethics, craftsmanship is expressed as the spirit of dedication to work and selfless devotion as well as the sense of responsibility to do one's duty. At the level of professional and technical behavior, craftsmanship is expressed as the spirit of inquiry focusing on details and the consciousness of innovation and bold breakthroughs. The recognition and love for a profession are the foundations of craftsmanship. People will only develop professional trust for excellence and pursue the best if they have deep identifications with their professions.

4. Targeted suggestions

4.1. Strengthen ideological and political education

Higher vocational schools tend to overemphasize the cultivation of professional spirit, while neglecting ideological and political education. These institutions should fully integrate the cultivation of craftsmanship spirit into ideological and political education and combine the craftsmanship spirit with certain core values. Schools should educate students on vocational values when they first enter the school so that they can develop correct values and outlook on life. Teachers should encourage students to pay attention to technical development and recognize the inherent beauty of technology. Only when students have a better understanding of craftsmanship and the social value of technology can they realize the importance of craftsmanship.

4.2. Focus on cultivating craftsmanship

It is a common problem that vocational schools focus on professional course grades and employment rates, while neglecting the cultivation of craftsmanship. This has led to the neglect of moral education in many vocational schools. Higher vocational schools should put forward relevant policies to enhance the cultivation of craftsmanship spirit among students. Teachers should fully explore the nurturing elements in professional fields, such as the inspiring stories of how certain well-known experts have grown, in order to help students establish correct values and outlook on life. In addition to teaching sessions, teachers should also fully integrate craftsmanship into evaluation sessions. Besides, government agencies at all levels should assume craftsmanship as an important indicator to assess the school operation and talent training quality.

4.3. Strengthen school-enterprise cooperation

The cultivation of vocational talents should not be limited to school education; rather, students should also be taught on the production line of enterprises. Since the goal of vocational education is to supply skilled talents to enterprises, vocational education enterprises must focus on the integration of schools with enterprises and strengthen their cooperation with enterprises. Vocational schools should actively bring in experts and technicians from the industry to coach students like their own apprentice. Enterprise experts should pay attention to guiding students' outlook on life and emphasize the importance of skills in their teaching. Only in this way can students dedicate themselves to their work and take the initiative to ponder and learn about technology when they step into their workplace in the future.

4.4. Integration of professional learning with the cultivation of craftsmanship

Cultivating skilled talents is the core idea of vocational education. It is necessary to integrate craftsmanship into professional courses as it can effectively promote students' skill learning. Along with professional courses, teachers should also share some of the diligent measures taken by experts to promote students' motivation for learning. The infiltration of craftsmanship into the professional field can help students better understand why and how they can learn. Any technology is a matter of excellence and research. It is extremely important to develop good habits such as rising to challenges and actively striving in the pursuit of learning.

4.5. Cultivate craftsmanship in various practical activities

Strengthening social practice is an important step to improving the overall quality of students in vocational schools and cultivating their craftsmanship spirit. Practical activities are important not only to improve students' professional skills, but also to cultivate craftsmanship among students. Higher vocational schools should encourage students to actively participate in social practice activities. Through practical activities, students will develop a certain sense of identity with their profession and realize the important role of craftsmanship.

5. Conclusions

Nearly a century ago, Huang Yanpei proposed the principles of "using both hands and brains" and "doing and learning together." According to Huang, theory and practice are parallel and equally important. He emphasized the importance of both knowledge and skills and proposed the idea of making those unemployed employed and those who are employed enjoy their work, which is in line with the spirit of craftsmanship. Due to the upgrading and intelligence of industrial development, the number of people working purely by hand is decreasing; therefore, the advocacy of craftsmanship has weakened in today's society. At present, China is in a critical period of transformation from "Made in China" to "Created in

China," and the society has put forward higher requirements for skilled talents. Industrial upgrading is inseparable from high-level skilled talents. The mastery and proficiency of skills are inseparable from craftsmanship. In the process of promoting quality education and accelerating education reform and development, higher vocational schools should integrate craftsmanship with vocational education.

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Author contributions

S.W. and F.P. conceived the idea of the study and wrote the first draft of the paper. J.Q. revised the format of the article.

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Analysis on Developing English Speaking Through Reading in Junior Middle Schools

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Abstract: In terms of English education, much research has been done on the combination of reading and writing, but there are relatively few studies on the combination of reading and speaking. In this study, the combination of reading and speaking in English through activities was expounded. The effect of this teaching mode was studied based on students' understanding of the subject, practical application, and transfer of knowledge. The goal of this teaching mode is to develop students' core literacy and to enable them to interpret and utilize text resources. With these as objectives, teachers can design lessons and evaluations that require students to verbally explain what they understand after reading lessons and guide students in a stepwise manner, from superficial text understanding to in-depth understanding and eventually to thinking beyond text learning, so as to promote the integration and development of students' language skills, cultural awareness, thinking, and learning ability.

Keywords: English learning activities; Junior middle school; Reading lessons; Oral activities; Core literacy

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1. Introduction

Through classroom observation and analysis, the new English teaching mode has been highlighted in many studies since the new curriculum reform. The traditional simplistic teaching and mechanical learning method of the English language has been transformed into "independent, cooperative, and inquiry" learning. However, in the process of implementation, due to teachers' inadequate understanding of the new learning concept, there are some misunderstandings in the setting of learning goals and content, selection of learning methods, and evaluation of learning results. The students are still not proficient in English, especially in oral expression like daily conversations, and they are incapable of delivering well-structured sentences.

When it comes to post-reading activities, the most likely thing we would think of is writing activities. There are not many lessons in which reading and speaking are organically integrated, resulting in a relatively inefficient development of speaking skills through reading lessons. In recent years, with the gradual and comprehensive implementation of human-computer dialogue in English listening comprehension in junior high schools, teachers have begun to emphasize on how to improve students' oral skills through reading. Nevertheless, there are still many problems in spoken English output after reading in actual classroom, such as the lack of vocabulary, lack of content, overly simple sentence pattern, inaccurate expression, lack of continuity and logic in expression, and many more. In addition, due to the lack of understanding of the text, there is no valuable or in-depth discussion on the text. As a result, students lose interest in the subject, and their learning initiative and efficiency reduce. The reasons for the aforementioned problems are that reading and speaking are taught separately and reading is only taught up

to the comprehension level, falling short of in-depth analysis, evaluation, and creation. Therefore, this paper presents some effective ways to cultivate students' oral skills in English reading teaching through activities, tap the educational value of reading texts, organically integrate oral output into reading lessons, and allow students to be guided by the theme of the text. Through careful design and guidance from teachers, students can express their thoughts verbally, which in turn improves their language skills, thinking, cultural awareness, and learning ability.

2. Role of reading and speaking activities

Activities based on the combination of reading and speaking not only encourage active learning, knowledge combination and application, and learning through analogy, but also promote the improvement of students' higher-order thinking and problem-solving skills. This teaching mode focuses not only on the learning results, but also the learning state and process.

2.1. Collaboratively revitalizing other course content through dynamic oral expression and learning strategies

According to the needs of the core literacy training objectives, the "2022 Compulsory Education Edition New Curriculum Standards" has introduced a course content integrating six elements: thematic context, discourse type, language knowledge, cultural knowledge, language skills, and learning strategies. Therefore, it is clear that language skills and learning strategies will revitalize not only language knowledge and cultural knowledge, but also thematic and discourse knowledge, highlighting the significance of each element to students' development [1]. In reading lessons, teachers should encourage students to read conversations intensively and carefully, make structural analyses of the conversations, and convert reading into speaking by learning from "what to read" and "how to read it out" to "what to say" and "how to say it." In this way, students will be able to analyze texts critically and in an in-depth manner. Therefore, by incorporating speaking in English reading lessons, students' oral expression and ability to think critically can be improved.

2.2. Evaluating students' comprehension of the text through oral expression

Among the five language skills (listening, speaking, reading, watching, and writing), reading, listening, and watching are comprehension skills, while speaking and writing are expression skills. Therefore, the training of combining reading and speaking can also be understood as reflecting the degree of students' understanding of the text and knowledge construction as well as the practical application level of critical thinking through oral expression. Teachers can evaluate students' level of reading through their oral expression and evaluate their learning progress from aspects like what they understand and express, what will they do or not do after understanding the text, and many more. Teachers can then provide timely feedback and the necessary support according to their problems and needs, thus achieving the teaching objectives and eventually the goals of education [2].

2.3. Using question chains to guide oral expression to promote deep learning

Question design is an important aspect in English reading in which it is crucial for generating thoughts and improving comprehension ability. Effective questioning can guide students to have a higher level of thinking. Therefore, question chains are widely used as a tool for developing critical thinking in teaching.

The theory of deep-thinking states that learning is not only a cognitive process, such as individual perception, memory, and thinking, but also a social construction process rooted in social culture, historical background, and real life [3]. Bloom's classification of levels of cognitive dimension in *Taxonomy of Educational Objectives* indicates that there are two types of learning: shallow and deep learning. He divided

learning into six levels, which are remembering, understanding, applying, analyzing, evaluating, and creating. Among the six levels, knowing and understanding are considered shallow learning, while the four higher levels (applying, analyzing, evaluating, and creating) are considered deep learning. These levels not only involve memory, but also focus on the application of knowledge and problem-solving [4]. In reading comprehension, teachers can carefully design question chains to guide students from knowing and understanding to critical and creative expression beyond the text. There are different ways to classify the types of questions: literal, inferential, and assimilative questions. These three types of questions are based on Bloom's six levels of learning, which are prerequisites in students' reading, as shown in **Table 1**.

Table 1. Correspondence table of question type, cognitive level, and thinking level [5]

Question type	Literal		Inferential		Assimilative	
Cognitive level	Memorize	Understand	Apply	Analyze	Integrate	Evaluate
Thinking level	Concrete thinking		Critical thinking		Creative thinking	

Being able to ask appropriate questions is a critical skill that foreign language teachers must have. Answers to questions at different levels not only reflect different cognitive levels, but also compel students to think further and help students visualize their thoughts clearly. Teachers should ask constructive questions and questions that can help students organize their thoughts, such as those that can relate the text to students' life based on what they understand, as well as use questioning as an important method to develop students' language expression and deep-thinking skills.

3. Principles of English oral skills through reading

3.1. Thematic education

Themes provide contextual categories for language learning and curriculum education, while texts carry language knowledge and cultural knowledge expressing those themes. Thematic context is one of the six elements of English course content. All activities that combine reading and speaking should be carried out in a certain thematic context. In that way, the core literacy of students can be cultivated throughout the process.

3.2. Using text as the basis for interpretation

According to Wang, the perspective and depth of text interpretation determine the quality of the lessons and ultimately students' learning level. Huang believes that the development of critical thinking in students must be based on texts. The essence of English reading lessons is to develop their reading skills and improve their thinking quality in the process of interpreting, understanding, and experiencing the texts, that is, to cultivate their skills in terms of perception, prediction, acquisition, analysis, generalization, and comparison.

3.3. Taking students as the main body

Teachers should be a guide to students in the classroom rather than a leader. Teachers should "return the classroom to the students," pay close attention to students' performance, provide timely guidance and assistance, stimulate students to think, and encourage students to actively express structured knowledge. For instance, teachers can prepare a sample of questions and answers and demonstrate how the conversation goes; the students will then be asked to converse with each other based on the template given. During this activity, teachers should take the opportunity to inspire and help them through the process. This would improve their language and interpersonal skills.

3.4. Constructing a well-connected teaching, learning, and evaluation system

According to the new curriculum standard, teaching, learning, and evaluation are closely related and interdependent in education. Therefore, teachers are to think about what to teach, why they are teaching it, and how to evaluate the outcomes of the lessons as well as establish a well-connected and systematic "objective-activity-evaluation" structure. Besides, teachers should integrate teaching and evaluation by designing their lessons based on the teaching objectives and reflect the dynamic, developmental, comprehensive, and formative characteristics of teaching evaluation in their lessons or activities [2]. Hence, when designing English speaking activities after reading, teachers should determine the concepts and content, analyze the learning situation, set goals, and choose appropriate teaching and evaluation methods (**Figure 2**).

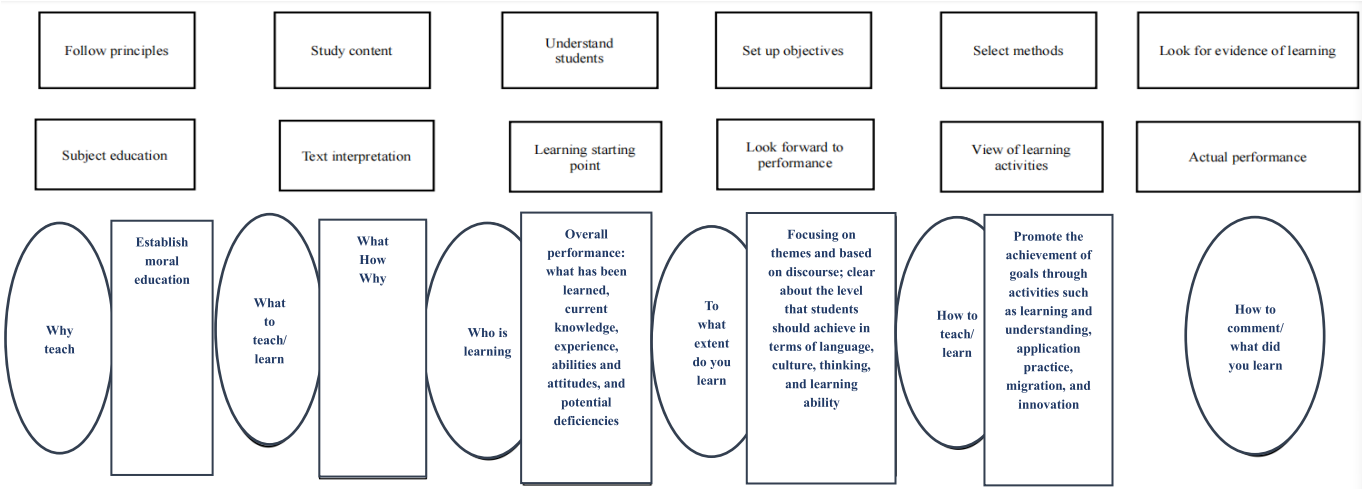

Figure 2. Design ideas for the integration of "teaching-learning-evaluation" [6]

3.5. Taking the goal of the "third-level pragmatic knowledge" of the curriculum standard as the basis

Pragmatic knowledge refers to the ability of accurately understanding others and expressing oneself. The "third level of pragmatic knowledge" of the curriculum standard requires one to understand the emotions, attitudes, and opinions of others and also be able to express those of their own using language [2].

3.6. Achieving the "third-level academic quality" standard of the curriculum standard

Academic quality standards provide an important basis for teachers to carry out literacy-oriented classroom teaching and evaluation. Academic quality refers to the academic performance of students after completing a course, reflecting the core literacy requirements [2]. The comprehensive performance of students' core literacy in different stages of schooling should be tested, which may be helpful to teachers to grasp the direction, method, and depth of teaching and evaluation. The test results may also help teachers in grasping the macro goals of core literacy, implement them into unit teaching and class hours, and ensure the coherence among the objectives, content, and methods. In this case, the lesson design is mainly based on the language comprehension and expressive skill requirements of eighth and ninth grades [2].

4. Developing English writing and speaking skills through activities

The new curriculum standard advocates the practice of English learning activities by "integrating learning and thinking, with innovation as the foundation." Adhering to the concept of "learning through experiencing, applying through practice, and innovating through transfer," students are encouraged to focus on real situations and problems, apply what they know, and participate in a series of language learning and application activities. The integration and development of one's own language knowledge, language skills,

cultural connotation, thinking, value orientation, and the application of learning strategies should be encouraged. The combination of observation, reading, and theory in English learning activities should be based on the text and students' knowledge [2].

4.1. Design of oral activities in reading and comprehension activities

Learning and comprehension activities mainly include perceptual attention, acquisition and sorting, as well as generalization and integration. It is necessary to create real and reasonable learning situations and tasks, activate students' existing knowledge, introduce language and cultural knowledge, identify the problems that need to be solved, and encourage students to form connections between learning topics and existing knowledge and experience, to discover their own cognitive gaps, and to look forward to the next lesson. Classroom teaching and learning activities should have clear logical relationships to help students construct knowledge.

4.1.1. Creating realistic and reasonable learning situations and tasks, and promoting students' expression of themes through perception and attention

According to Jiang, the tasks given in class should be related to the students' existing knowledge and experience, so that students can relate the content to their lives, thereby stimulating their interest and desire to learn. They can then mobilize what they know, explore the meaning of the theme, and independently construct, consolidate, and transfer new knowledge, as well as participate in practical activities centered on communication and expression. In this way, their contextual and pragmatic awareness can be enhanced, and they can use what they have learned to analyze and solve problems.

Taking the People's Education Press (PEP) English textbook *Go for it! Grade 8, Volume 1, Unit 7: Do you think you will have your own robot? Section B, 2b* [7] as an example, pre-reading videos, music, and pictures can be used to illustrate real situations. Tasks can then be assigned to students to help them understand the meaning of the topic, form new knowledge structures, and output information through spoken language.

This text is an expository text, and the theme is science and technology under the category of human and society. The content of the discourse introduces the status quo of robots and different predictions for future development. By reading the text, students will be able to gauge the usual structure and language used in expository texts, thereby stimulating their interest in science, encouraging them to study harder, and eventually inspiring them to create a better tomorrow with their own wisdom. Based on the analysis and investigation above, the text can be taught using the following structure (**Figure 3**).

Before reading the text, students are required to answer several questions by watching relevant videos, understanding the theme of the text, and paying attention to Musk's predictions about life in the future. Students can observe the text titles and pictures to further understand the topic of the text and answer those questions through group discussions. Through these activities, their prior knowledge about robots will be activated, and students will be able to learn future tenses and other text-related vocabulary in the prediction of the future with robots, as shown in **Figure 4**.

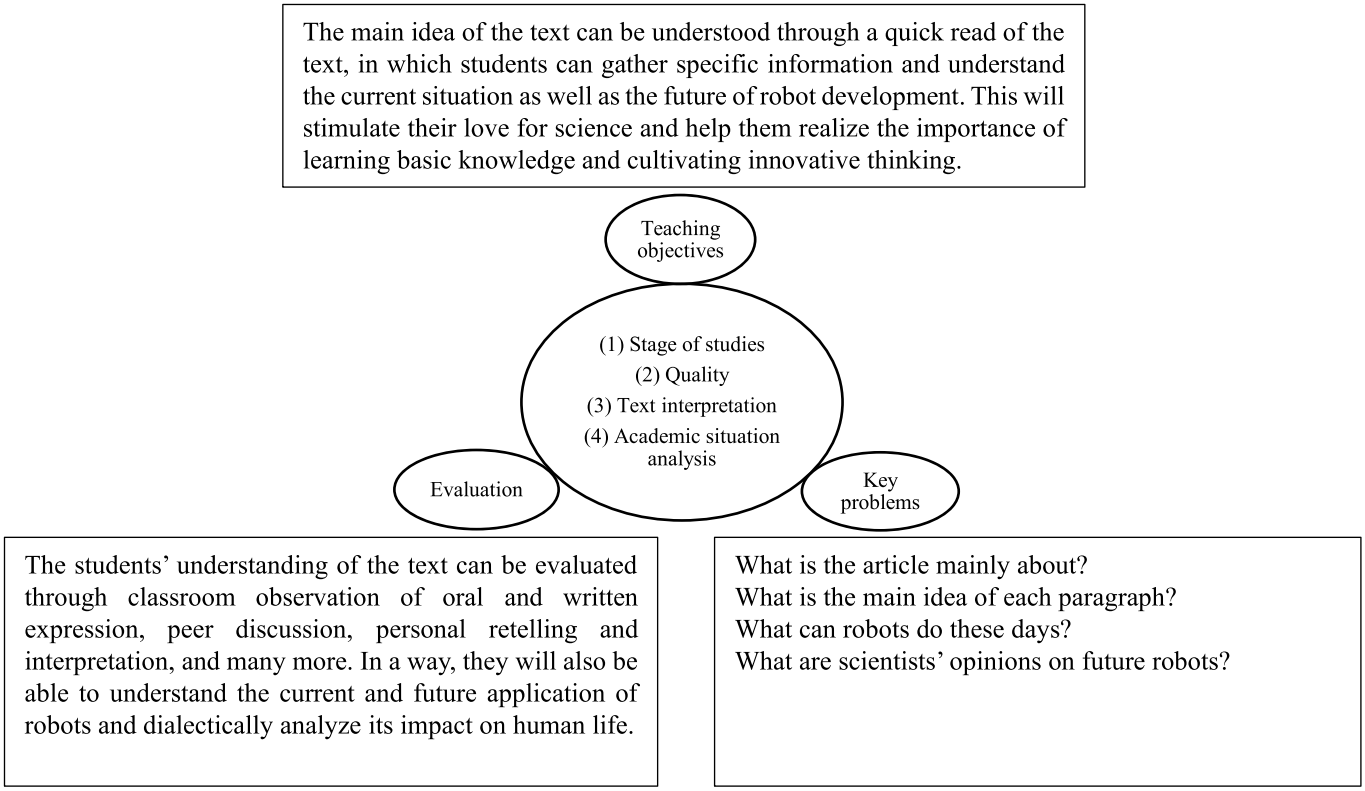

Figure 3. Frame diagram of instructional design for reading class of *"English" Go for it! Volume 1, Grade 8, Unit 7, Section B, 2b*

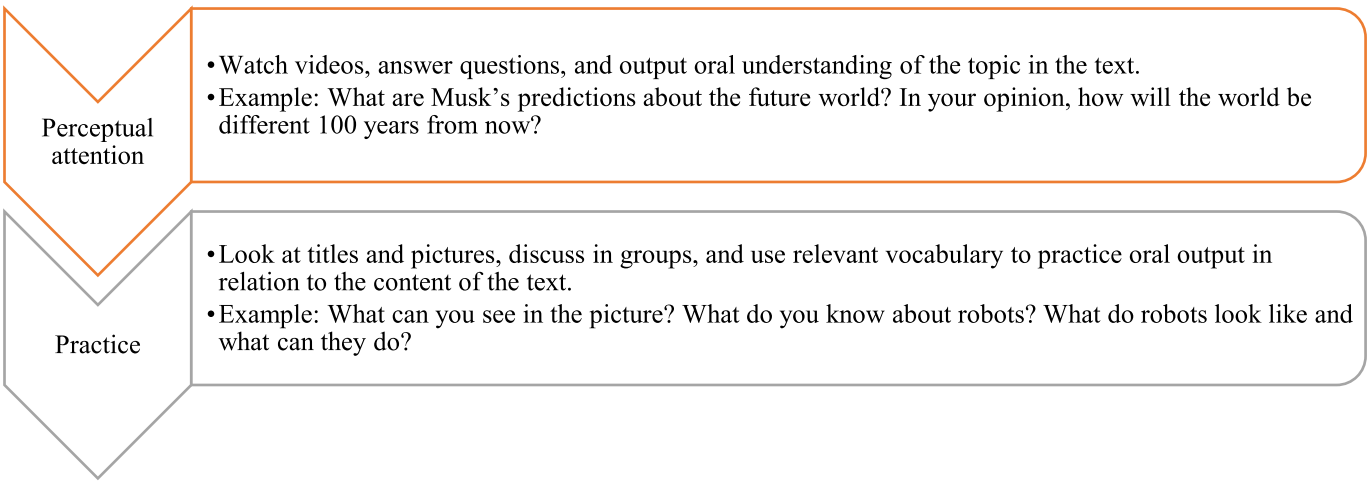

Figure 4. Learning and understanding activities

Evaluation: Teachers should evaluate whether the students' answers to Musk's prediction of the future are comprehensive and specific and whether the language used is correct. While listening to the discussions carried out, teachers should evaluate whether the students can understand the topic and use the correct vocabulary, sentence structure, and future tenses to express themselves.

Design intent: Let students to feel that the learning content is closely related to their own lives, stimulate their own interest, mobilize what they know, and explore the meaning of the theme. Teachers can supplement some core vocabulary around the theme if needed, pave the way for background knowledge, and trigger students' cognitive conflicts and reading expectations. Besides, this activity also helps teachers gauge students' prior knowledge of certain topics and identify their zones of proximal development.

4.1.2. Guiding acquisition and sorting, generalization and integration, and expression of structured knowledge through question chains

Under the guidance of a theme, relying on the text, and being goal-oriented, question chains would help develop students' language learning and skills and help them express their learning at different stages.

4.1.2.1. Obtaining and sorting out specific information in the discourse, and performing oral output exercises on the specific content of the discourse

By reading a text and understanding the main message from the questions that point to key information in the text, students can acquire and sort out information, establish connections between scattered information, and form structured expressions based on the topic. Examples of questions are shown below.

(1) What can robots do?
(2) What are robots like and what will they be like in the future?
(3) What opinions on future robots are mentioned in the article?

4.1.2.2. Summarizing and integrating the discourse structure, and carrying out oral output exercises

Students can read the text in detail and then obtain and summarize the status quo and future development of robots in the text by answering the questions. Besides, they will be exposed to different views on the futuristic development of robots.

Table 2. Questions in each paragraph of *"English" Go for it! Volume 1, Grade 8, Unit 7, Section B, 2b*

Paragraphs	Main questions
Paragraph 1	Introduction: What are robots like in movies?
Paragraph 2	Today's robot: What can robots do today?
Paragraph 3	Future-disagreement: Will robots think like humans in the future?
Paragraph 4	Future-prediction: What will robots be like in the future?

Students will then summarize and integrate the discourse structure, draw out a mind map of the discourse and retell the main content of the discourse according to the mind map.

(1) Read the passage again and draw a mind map of 2b (**Figure 5**).
(2) Retell 2b with the help of the mind map.

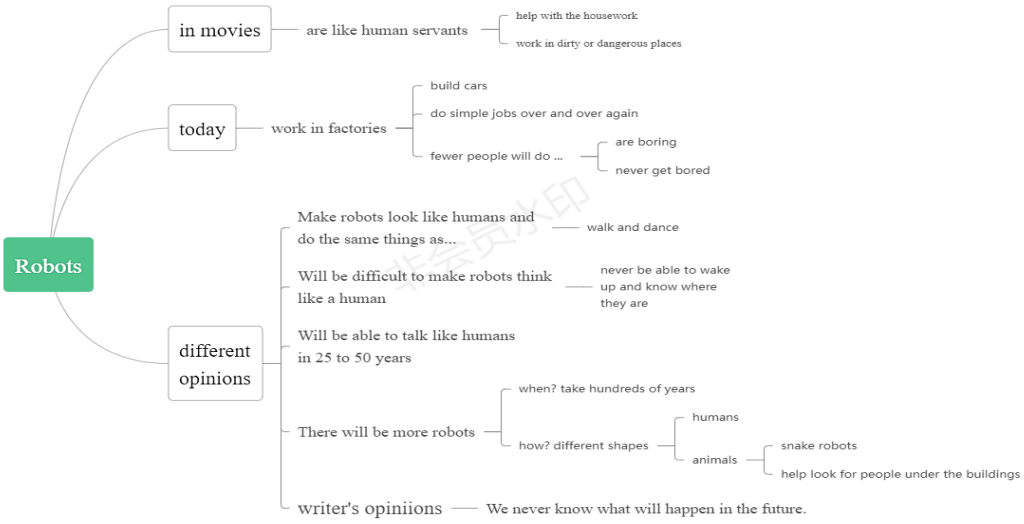

Figure 5. Mind map of *Go for it! Volume 1, Grade 8, Unit 7, Section B, 2b* [2]

Evaluation: The teacher evaluates whether the students can retell the main content of the text correctly, fluently, and logically through observation and simple and continuous questioning. In addition, the vocabulary, sentence structure, and grammar in relation to the theme, and the accuracy of expression are evaluated. In this way, the problems in the learning process can be identified in a timely manner, and this would help students achieve the preset teaching goals.

Design intent: Let students acquire, sort out, summarize, and integrate basic information about robots and the different views on the futuristic development of robots as well as use mind maps to construct and present the information. Mind maps help students understand the content of the discourse as well as summarize and integrate the content structure and language characteristics of the discourse. By building an information chain bracket, students will learn to expand words into sentences according to this information chain, from sentences to paragraphs, from paragraphs to articles, and eventually to verbally reproducing the text, thereby improving their English expression ability.

4.2. Oral English design in reading application practice activities

Applied practice activities mainly include description and interpretation, analysis and judgment, as well as internalization and application. Through speaking activities, students will be able to internalize language knowledge and cultural knowledge, deepen their understanding of cultural connotation, consolidate structured knowledge, and promote the transformation of knowledge into skills. After learning and understanding the text, the initial output is carried out by retelling the main content of the text, setting up question chains, role-playing, and other forms.

In this study, several texts from the PEP English textbook *Go for it!* are used as examples to discuss some effective strategies for the design and implementation of English oral activities after reading.

4.2.1. With the help of visual tools, the main content of the text is described and explained

Different articles have different structural characteristics due to their different genres and themes, providing us with the possibility of transforming text into different forms of structured graphics. For example, we can use mind maps, timelines, table structure diagrams, and even comic strips to transform texts into pictures according to the different characteristics of the text to help students sort out and integrate information.

4.2.1.1. Using mind maps to carry out post-reading retelling activities

For example, in the PEP English textbook *Go for it, Grade 7, Volume 1, Unit 8, Section B, 2b* [8], Thanksgiving in North America is presented under the theme of holidays and celebrations, which is under the category of people and society. A mind map can be drawn to sort out the structure of the article, as shown in **Figure 6**.

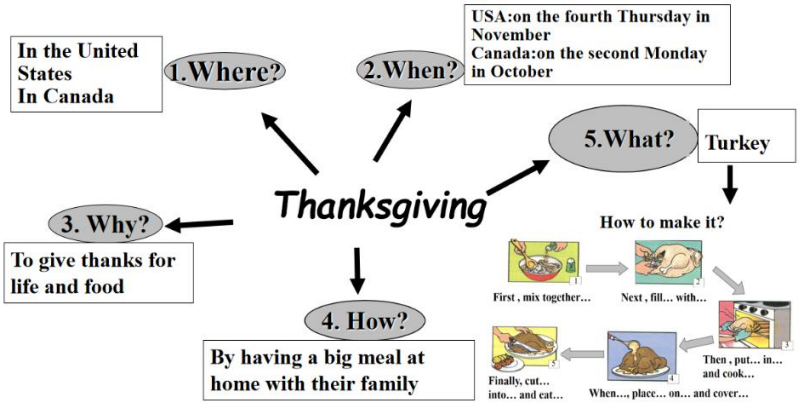

Figure 6. Mind map of *Unit 8 Section B, 2b* Thanksgiving in North America [2]

4.2.1.2. Using comic strips to retell after reading

For example, in the PEP English Textbook *Go for it! Grade 7, Volume 2, Unit 12, Section B, 2b* [7], the theme of the text is harmonious coexistence of man and nature, which is under the category of man and nature. The text presents an interesting and unique experience of a person who encountered a snake when camping by a lake in the rural area of India during a weekend. Comic strips can be used to sort out the structure of the text and retell it, as shown in **Figure 7**.

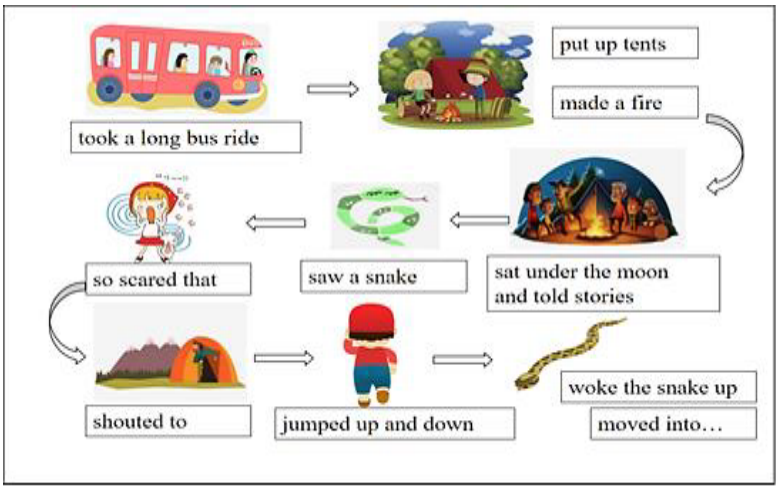

Figure 7. PEP English Textbook *Go for it! Grade 7, Unit 12, Section B, 2b* in the form of comic strip

4.2.1.3. Using a timeline diagram to retell a text after reading

For example, in the PEP English textbook *Go for it! Grade 8, Volume 1, Unit 5, Section B, 2b* [8], the theme of appreciation of Chinese and foreign art forms and cultures, which is under the category of people and society, is presented. The text explains the origin, achievements, and reasons for the popularity of the cartoon character "Mickey Mouse" in American culture. In this case, a timeline diagram can be used to help students retell the text, as shown in **Figure 8**.

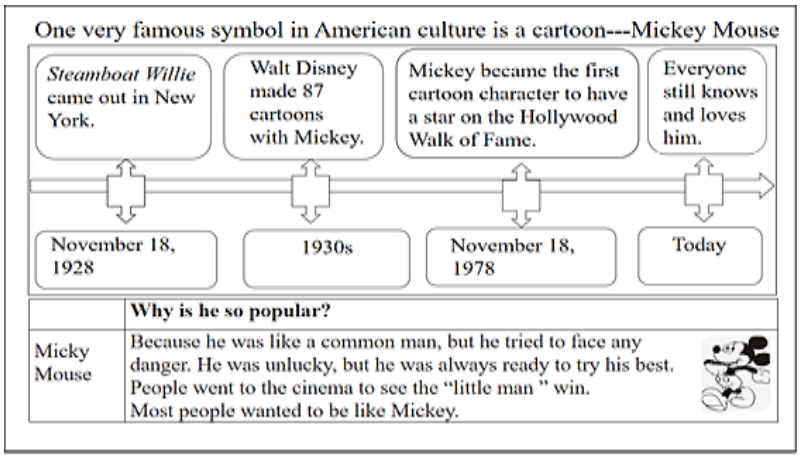

Figure 8. Timeline diagram of PEP English textbook *Go for it! Grade 8, Volume 1, Unit 5, Section B, 2b*

4.2.1.4. Using an information table for post-reading retelling activities

For example, the theme of the text in the PEP English textbook *Go for it! Grade 8, Volume 1, Unit 3, Section B, 2b* is interpersonal communication under the category of people and society. The text describes the similarities and differences between Jeff Green, Huang Lei, and Mary Smith, as well as their opinions on friends. The text can be retold using a table, as shown in **Figure 9**.

	Opinions	Similarities	Differences
Jeff Green	You don't need a lot of friends as long as they're good. (the same)	They are both quiet.	
Huang Lei	It's not necessary to be the same. (different)	They both like sports.	Larry is taller and more outgoing. Larry plays tennis better. Larry is less hard-working. Huang Lei gets better grades.
Mary Smith	I don't really care if my friends are the same as me or different.	They can talk about and share everything.	Carol is really kind and very funny.

Figure 9. Content of PEP English textbook *Go for it! Grade 8, Volume 1, Unit 3, Section B, 2b* in a table

After introducing several activities for speaking after reading according to different article genres and themes, the students' ability to describe or explain can be evaluated based on the dimensions below.

(1) Integrity of content: The student is able to describe the main content of the article with his/her structure diagram.
(2) Accuracy: The student is able to retell the main content of the article with correct vocabulary, sentence patterns, and grammar.
(3) Logic: The text is retold by using appropriate vocabulary with logical relations.
(4) Fluency: In the process of retelling, the student is able to avoid pauses and repetitions in an effort to keep the sentences smooth and coherent.

4.2.2. Optimizing question design, and analyzing and judging based on text content

In reading activities, by setting hidden questions or question chains in the text, students can analyze and evaluate the reading materials so as to cultivate logical and critical thinking. Taking a text in *Go for it! Grade 8, Volume 1, Unit 7, Section B, 2b* [8] as an example, the question chain allows students to think critically and express their opinions based on the text. As explained earlier in section 4.1, four questions are posed to help students understand what robots are like in movies, in real life, and in the future. Based on the text, scientists also have differing opinions on the question: "Will robots think like humans in the future?". Some believe that robots will be able to think like humans, while others believe that robots will never be able to think like humans. This is a very controversial topic. After reading the text, students will be eager to express their opinions based on their own cognition. In order to help students express themselves clearly and improve their thinking, a chain of questions is designed, as shown in **Figure 10**.

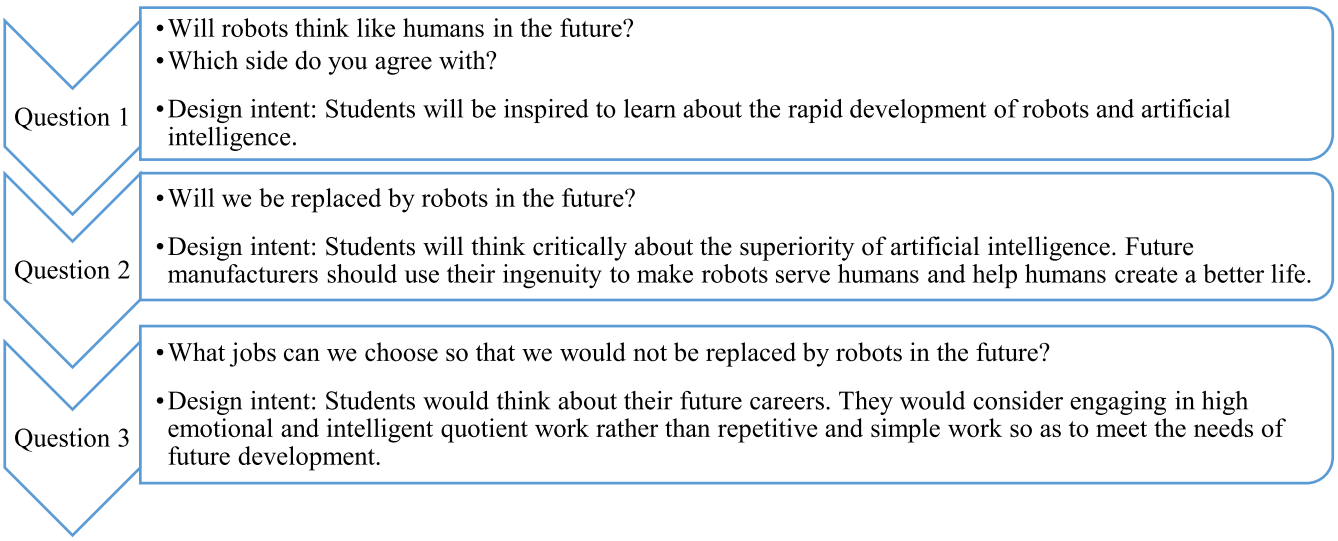

Figure 10. Design of question chain after reading the text in *Go for it! Grade 8, Volume 1, Unit 7, Section B, 2b*

Evaluation: When students express their opinions freely according to the question chain, the teacher should encourage students to be bold in expressing themselves by accepting their answers as long as they are reasonable and well-founded.

4.2.3. Through role-playing, internalize and apply what you have learned, and deeply express the emotions of the characters in the text

Role-playing is a commonly used form of oral English activities. For narrative texts, dramatic texts, and news story texts with many characters and dialogues, post-reading role-playing can be used so that students can retell the content of the text. In this way, students will be encouraged to imagine and make reasonable innovations, enriching the text content and expressing the emotions of the characters.

For example, in the PEP English textbook *Go for it! Grade 7, Volume 2, Unit 3, Section B, 2b* "Crossing the River to School," there is a news article with the theme of changes in hometown under the category of people and society, which is based on a true story of children going to school by a ropeway in a remote mountainous area in China. The students can retell the news story by sorting out of the article, as shown in **Figure 11**.

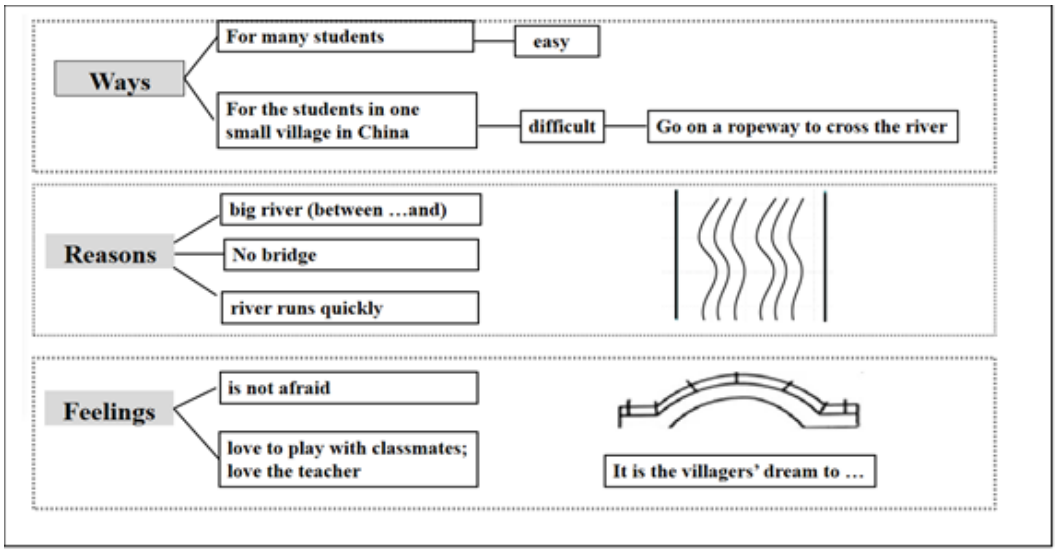

Figure 11. Mind map of *Unit 3, Section B, 2b* "Crossing the River to School" [2]

On this basis, we can design two role-plays to interpret the different scenarios of Liangliang's interviews in 2010 and 2022, as shown in **Table 3**.

Table 3. Different scenarios of Liangliang's interviews in 2010 and 2022

2010	2022
The interview can be enacted based on the dialogue given.	By supplementing the government's report on bridge and road repairs and watching the video of the dramatic changes in people's lives in the Nu River today, the scenario when the reporters interviewed Liangliang is imagined.
Role-play the interview. **Reporter:** How do you get to school, Liangliang? ***Liangliang:*** *...go on a ropeway...* **Reporter:** Are you afraid? ***Lian liang:*** *No./ Because I love/ my school / my teachers. / play with my classmates.* **Reporter:** Is it difficult for you to go to school? ***Liangliang:*** *Yes, it is.* **Reporter:** Do you want to have a bridge? ***Liangliang:*** *Yes. It's our dream.* **Reporter:** I'm sure your dream can come true. 	**Interview Time.** **Choose at least 4 questions to make an interview with Liang liang.** **Reporter:** ➢How do the students in the village get to school now? ➢What's the benefit of building the bridge? ➢What makes the great changes happen? ➢How do people feel now? ➢What's your biggest dream now? ➢What else do you want to say? ... 

Through the role-playing activities, the students will not only understand the difficulties that Liangliang faced when going to school, but also feel the significant changes in life after more than 10 years. From this, students will realize that they should be optimistic and filled with gratitude in life, thus learning how to cherish life. Teachers can observe from the students' language, performance, and creativity whether they have a deep understanding of the text and its value.

4.3. Design of innovative speaking exercises in reading lessons

The speaking exercises should help develop reasoning and argumentation, criticism and evaluation, as well as imagination and creativity. Students should be guided to reason and demonstrate the value orientation behind the text as well as the attitude and behavior of the protagonist. Students will then understand the world from different perspectives and be able to express emotions, attitudes, and opinions rationally.

For example, the theme of *Unit 8* "Have You Read Treasure Island Yet?" in the PEP English textbook is literature and art under the category of human and society. *Section B, 2a–2e* is the reading board. By reading articles, obtaining detailed information, consolidating information, and grasping the core idea of each paragraph in the article, students will be able to summarize the general idea of the article. Students will be able to analyze why patriotic music has the power to change lives, and then associate it with other types of music and share their understanding of the power of music. In this way, they will develop a positive attitude toward life.

4.3.1. Developing reasoning and argumentation abilities based on what is learned from the text

Based on their understanding of the power of music, students can use the viewpoints and language in the text and discuss in groups about their understanding of famous sayings about music by Confucius and Einstein as well as explain the reasons.

(1) "If I were not a physician, I would probably be a musician. I often think in music. I live my daydreams in music. I know that the most joy in my life has come to me from my violin."—Albert Einstein
(2) "Music produces a kind of pleasure which human nature cannot do without."—Confucius

Design intent: Students can associate music quotes and stories, transfer them, think and share their understanding of the power of music, make simple verbal evaluations based on the content, viewpoints, and attitudes of the written text, and explain the reasons.

4.3.2. Developing the ability to evaluate viewpoints, empathize with others, and express critically

Teachers should guide students to analyze the meaning of the text and the emotional attitude of the protagonist in an in-depth manner, think rationally, and critically evaluate the text. Since critical thinking itself is a kind of high-level thinking process that requires certain questions, it is necessary to design a question chain [6]. Teachers can set the following question chain according to the emotions of the protagonist in the text:

(1) Play some patriotic music for the students to listen to and ask the students to guess what song the protagonist (Sarah) listened to.
(2) Ask the students to share how they felt when they were listening to the music.

Design intent: Students will grow to enjoy music, guess the song Sarah listened to, further understand the content of the text, appreciate and feel the charm of patriotic music from the perspective of the protagonist, learn to appreciate different cultures, and form positive cultural concepts. Students will also be able to verbally express the theme of music with clear views and logic.

4.3.3. Thinking beyond the text, and imagining and creating expressions

After understanding the profound meaning of the text, students will learn to imagine and express their views and opinions creatively.

(1) Students can write their own stories with music and then discuss and share in groups.
(2) Students can share their music-related stories with the help of the following questions:
    (i) What is your favorite kind of music and songs? Why?
    (ii) Who is your favorite musician? Why?
    (iii) What is the power of music for you?

Design an evaluation rubric like the one shown in **Table 4**. Adequate support should be offered to students to improve their English expression, help them achieve the education goals, and synergize teaching, learning, and evaluation so as to promote student development.

Table 4. Evaluation rubrics of students' imagination and creation of oral expression

Pronunciation (2 marks)	Content (5 marks)	Logic (3 marks)	Total (10 marks)
Clear pronunciation.	Able to use words and phrases from text and add extra words and phrases. For example, the importance of (a) "It reminds us that..." (b) "It brings us back to..."	Use clear logical words such as the following: First, …, Second, …, Last but not least, ….	

Design intent: Problem-oriented; students' imagination and expression will be stimulated beyond the text through the problem chain. Besides, students will be able to use the language learned in the text to describe and introduce the people and things around them verbally as well as express their emotions, attitudes, and opinions appropriately.

4.3.4. Comprehensively applying what they have learned and know, and expressing their views and opinions through discussions and debates

Students should be guided to understand the deeper meaning of the given text, evaluate the article, and use critical thinking methods, such as reasoning and analysis, to express their views and opinions.

Among the articles in PEP English Textbook *Go for it!*, there are articles that are debatable and require one's own interpretation. For example, when reading *Grade 8, Volume 1, Unit 3, Section B*, Jeff Green, Huang Lei, and Mary Smith gave different views on the topic "Should friends be the same or different?". Jeff Green believes that good friends are like a mirror, expressing his favor for friends who are similar to himself; Huang Lei, on the other hand, used the example of a mutually beneficial relationship between himself and his friends to express the view that good friends do not have to be the same; Mary Smith expressed that she does not care about whether her friends are the same as herself or not since a true friend is someone who reaches out to you when you are in trouble. Through reading the text, students can fully express their views on this topic. As another example, in *Go for it! Grade 8, Volume 2, Unit 3, Section B, 2b* [7], the text concerns two parents discussing the topic "Should students do housework?", each having their own opinions and giving their own reasons. Such topics are closely related to students' lives. After reading the text, students will have their own opinions based on their life experiences and what they have learnt. Students can then express their views via open discussion or debate.

5. Conclusion

The activity of combining reading and speaking is a comprehensive and creative classroom learning activity. It not only exercises and improves students' ability to analyze, summarize, and integrate information from a text, but also helps in developing their high-level thinking ability, including reasoning, critical evaluation, imagination, and creation. Therefore, for English reading lessons in junior high schools, teachers should strengthen the design of oral activities after reading, cultivate students' ability to relate to the texts and the author, and form their own thoughts. Besides, these activities will help students build a proactive learning attitude, improve their key abilities, and develop their character and English core literacy. Therefore, teaching strategies that combine speaking and reading are proposed to encourage English speaking. Besides, several methods to cultivate students' critical thinking and language ability through reading and speaking activities are also proposed to improve their oral expression. The teaching that follows the laws of students' cognitive development is operable. However, lessons combining reading and writing still need to be studied and implemented according to different text types and learning situations as well as further optimized and improved in practice.

Disclosure statement

The author declares no conflict of interest.

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Research on Postgraduate Classroom Construction Framework from the Perspective of Smart Education

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Abstract: Smart education is the future and development direction of higher education. Taking the graduate course Crime and Police Theory as the research subject, the shortcomings of smart education, which include the lack of understanding of the concept of smart education, the limited content structure of smart education, the poor cognition of smart education among teachers and students, and inadequate hardware and technical support for smart education, are systematically analyzed. In view of these shortcomings, several strategies are proposed, including improving the smart education curriculum development plan and management level, ensuring the construction quality of smart education projects, and raising funds for smart education construction from various sources.

Keywords: Smart education; Smart environment; Graduate student; Construction framework

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1. Introduction

From the traditional era to the digital era and even the future intelligent era, smart education is an inevitable system in education [1]. According to the "Overall Layout Plan for the Construction of Digital China," building a "Digital China" is an impetus for advancing China toward modernization in the digital era and a strong support to creating a new national competitive advantage. In face of the new situation, traditional higher education has been challenged to some extent; the status of tertiary institutions as the main platform for knowledge popularization and skill teaching is deteriorating, the authority embodied in teachers' preaching and teaching are constantly weakened, and the teaching contents and methods of are changing [2]. The construction of smart classroom, as the tenet for the implementation of smart education and teaching, is the impetus for the advancement of smart education [3]. How can we better promote classroom teaching with the help of smart education? In this study, the postgraduate course of Crime and Police Theory was taken as an example to explore the feasibility of smart education practice in tertiary institutions in hope that this study would provide reference not only for the design of a smart education system, but also for an improved development of graduate education.

2. Problem orientation: Deficiencies in the construction of graduate smart education

2.1. Lack of understanding of the concept of smart education

With the release of China Smart Education Bluebook (2022), the theoretical and practical aspects of smart education have further developed. Various types of businesses, technologies and academic activities, such

as the World Digital Education Conference, the United Nations Educational, Scientific and Cultural Organization (UNESCO) International Forum on Artificial Intelligence and Education, and the Sino-American (US) Smart Education Conference, have emerge in an endless stream. However, for most frontline teachers, questions such as "What is the core concept of smart education?", "What smart education can bring to people?", "What schools and teachers should do?", and "How to implement it?" are still unclear. Smart education is both remote and unreachable even for a small number of teachers and students. Objectively speaking, for a considerable number of education practitioners, smart education is a new concept. People are still ignorant to the concept of smart education, such as flipped classroom, maker education, and online learning, and idealize them as "wisdom education." In fact, as an exploration and attempt, these practices cannot be simply equated to wisdom education.

2.2. Incomprehensive framework of smart education

After the national smart education service platform was officially launched in March 2022, it has made great progress through the third phase of construction. It is a national and comprehensive teaching resource service platform for higher education. As shown in **Figure 1**, it has five modules [4], comprising of several sub-modules, including curriculum, teaching materials, virtual experiments, academic teaching and research, extracurricular development, special topics, academicians' lectures, massive open online courses (MOOC), information on graduate education, *etc*. After registration, visitors can click the link to access relevant modules and view the video recordings of relevant courses. Research has found that the courses on the platform are linked to specific resources on the MOOC website by default after clicking [4]. Smart education is believed to be a systematic project, and the construction of its content structure is not limited to offering recorded courses on the open website. Objectively speaking, uploading teaching resources onto the network for sharing is an integral part of digital education. However, people cannot simply equate this work to smart education. In other words, smart education can bring more enriched contents to graduate education.

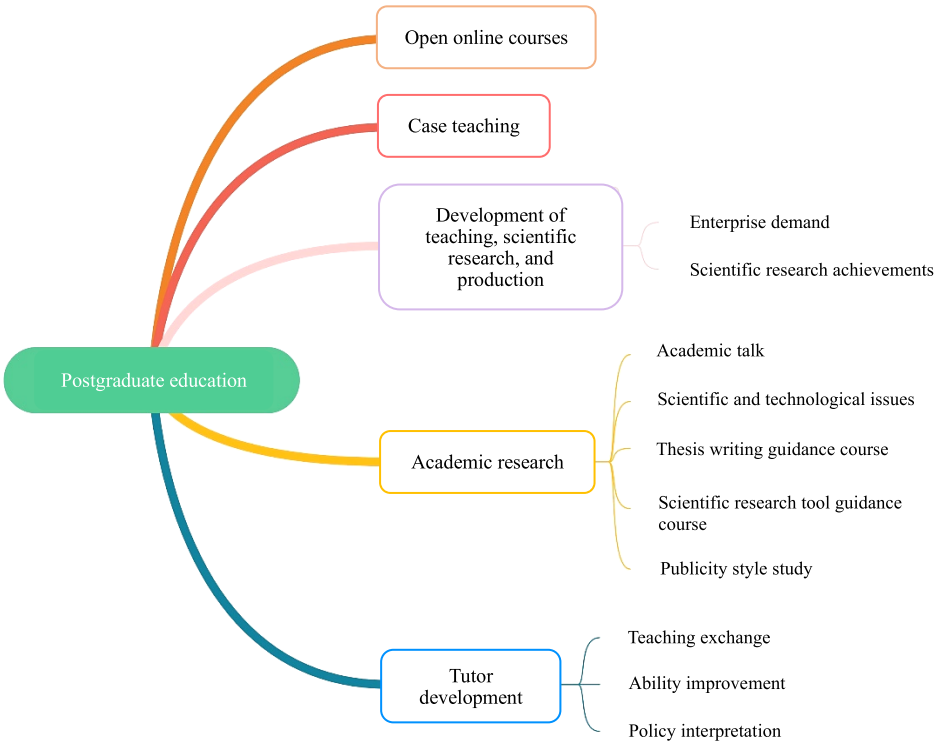

Figure 1. Smart education service platform modules in higher education

2.3. Poor cognition of smart education among teachers and students

Helping teachers understand, accept, and master the use of smart education software and hardware is an important task. In face of the new teaching module, the pressure of whole-process supervision, and the challenges brought on by unruly teaching evaluation, the impact of smart education on teachers can be said to be subversive. Higher education teachers are generally faced with high work pressure. They are required to take on the responsibility for various courses, teach multiple academic degrees (undergraduate, postgraduate, and doctoral), and complete hundreds of class hours in a semester. In addition, the heavy task of scientific research drains their extra energy and time to engage in smart education innovation. In addition, the new teaching module necessitates students to spend more time outside class hours to prepare for lessons. If the smart education module is adopted in every course, the countless tasks at-hand will create stress in students. As a result, they will be tired of coping, and this will diminish the constructive effect of smart education. All these are contrary to the original intentions of wisdom education. However, the development of students in these competencies prepares both teachers and students for new challenges and a rapidly evolving world by aligning formal education with informal education [5].

2.4. Inadequate hardware and technical support in smart education

The promotion and application of smart education cannot be separated from the support of science, technology, and hardware. As a complex system engineering, the technological innovation and practice of smart education require the technical support of enterprises. A study has found that general teachers, especially teachers of humanities and social sciences, lack the ability to develop smart education software. From using a piece of chalk and blackboard to slides and multimedia teaching, this process shows that the promotion of smart education requires not only time, but also the iterative development of technology. During COVID-19, when online teaching was widely used, security issues in information systems, such as "online course explosion," personal data leak, lack of control over online course processes, difficulty in achieving teaching results, *etc*., were exposed. These challenges and deficiencies can be taken as references for the design of smart education modules. In this way, we can continuously improve the technological level of smart education.

3. Construction framework: Practical approach of smart education

The characteristics of graduate classroom construction are as follows: small class size, strong interaction between teachers and students, high theoretical content, emphasis on the cultivation of scientific research ability, and rich and diverse forms of teaching. The construction needs both the support of the smart education module and the design of a core content. It can be carried out from the several aspects, as shown in **Figure 2** [6]. Combining curriculum construction with the smart education framework, several strategies are proposed.

3.1. Improving the smart education curriculum development plan

First, the concept of smart education should be refined. The Crime and Police Theory course aims to equip students with professional theoretical knowledge and practical service skills. By taking high-quality resources for teaching and learning, the course will be able to meet the personalized learning needs of police graduates. We must integrate smart education into the overall education ecology in schools, guide students' learning with smart education concepts, and build an environment for smart learning. The process of cultivating a smart teacher identity takes a long time and requires the awakening of the subject's will. However, the cultivation of this identity a strategic way for teachers to master and breakthrough technical constraints [7]. It would be beneficial to work closely with permanent and part-time instructors to improve teaching strategies and realize resource integration of universities, public security bureaus, enterprises, and

research institutions, provide an impetus for the transformation of the role of teachers in the new era, and ensure that the education ecology is keeping pace with the times and the development of modern information technology [8].

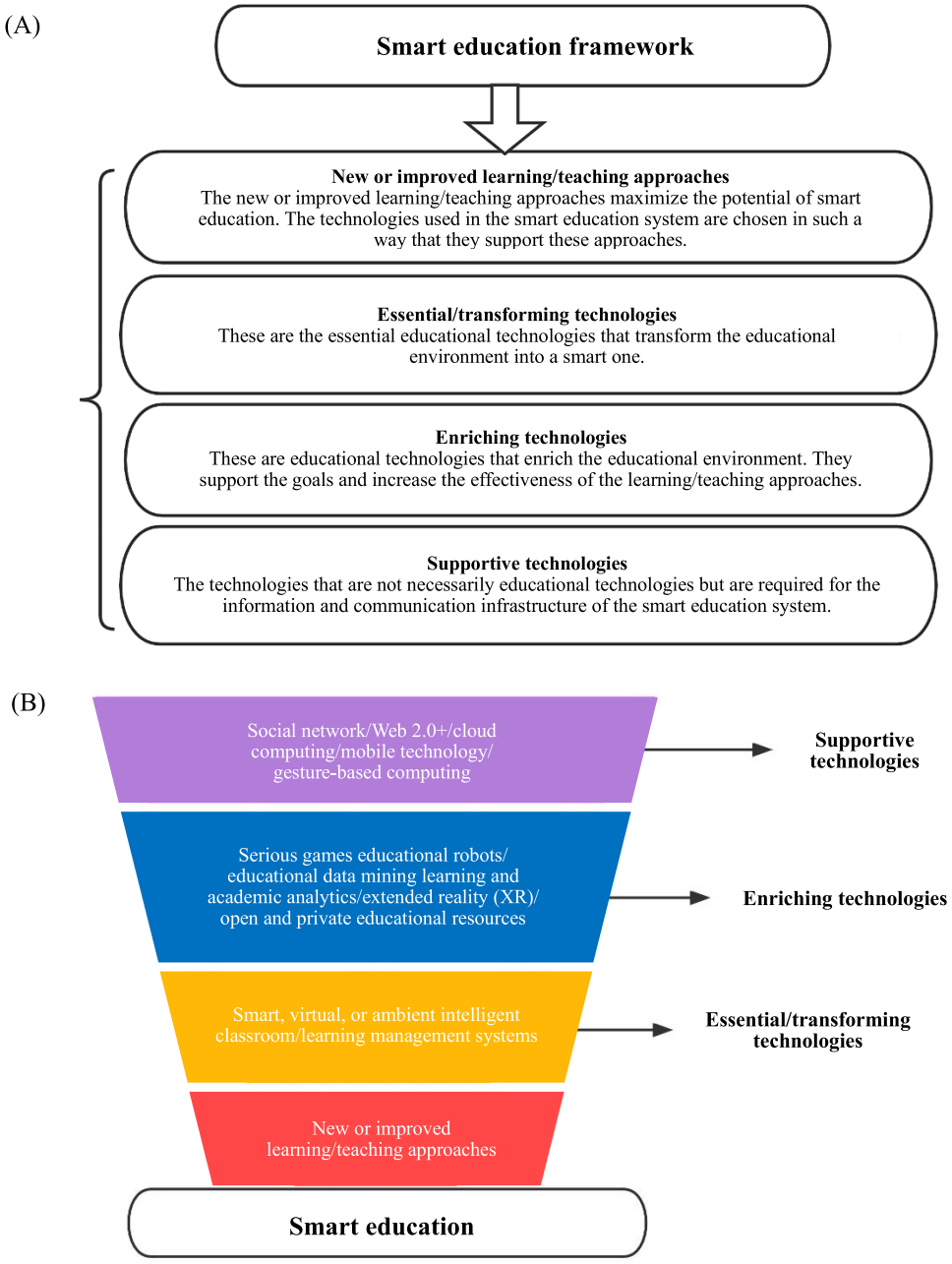

Figure 2. (A) Smart education framework. (B) Smart education technology framework [6]

Second, the smart education module design should be optimized. We should explore from the aspects of capacity innovation and system innovation and cultivate the ecological construction of Crime and Policing Theory with wisdom education; vigorously promote smart classroom, smart teachers, smart teaching research, smart evaluation, and other modules of Crime and Police Theory; as well as make full use of the smart classrooms and teaching systems that have been built in our school and make every effort to build a high-quality graduate education system. With the help of smart curriculum modules such as virtual simulation laboratory, simulated real combat block, immersive crime scene construction, *etc*.,

students' theoretical understanding of crime and practical combat ability will improve. From the standpoint of instructional methods, as shown in **Figure 3**, artificial intelligence (AI) can serve as an intelligent tutor, tutee, learning tool/partner, or policy-making adviser in education [9].

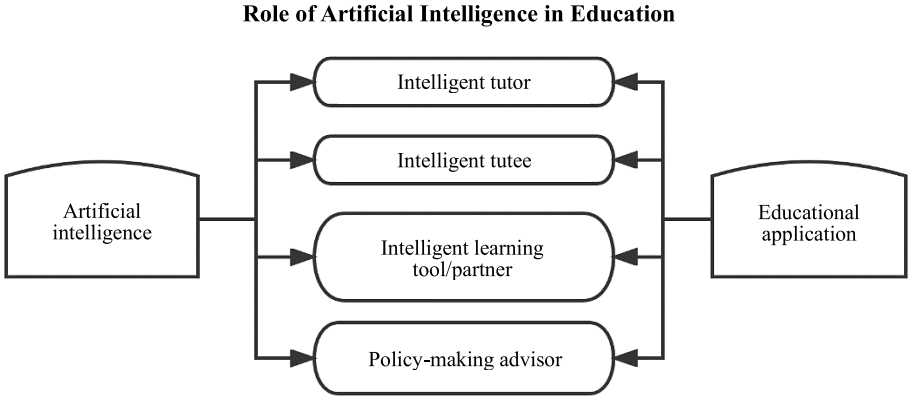

Figure 3. Role of artificial intelligence in education systems

Third, the academic characteristics of the course should be embalmed with smart education. The Crime and Police Theory course highlights the educational means of wisdom education and the academic characteristics of public security colleges in terms of teaching and learning. Focusing on the realization of the teaching objectives of criminology theory and practice, it observes a teaching content based on big data. We should further promote the exchange and interaction between lecturers and students as well as among students themselves and work together to build a knowledge map so that graduate students can better understand the basic theoretical content of criminology and the essentials of police practice in typical cases. Graduate students will be able to expand their knowledge on criminology through active learning and establish the concept of strict law enforcement by having laid a good foundation on the subject.

3.2. Improving the management level of smart education

First, the central position of students should be highlighted. The training for a police master degree is quite different from the undergraduate study of public security. Most of the students are police officers with rich practical experience in law enforcement. Therefore, they have more flexible thinking patterns and tend to focus on real crime scenes in classroom. More attention should be paid to the particularity of students. On the one hand, the course flexibly adopts blending learning and case-based teaching (CBT) approaches to achieve the goal of integrating theory with practice; on the other hand, it highlights the data, ladder, and informatization of instructional design and adopts the target teaching method, adhering to the idea of taking actual combat as the target.

Second, the objectives of the curriculum should be clarified. The reform of smart education should be clearly defined in the course, and the core teaching contents, which include crime phenomenon, causes, prevention, and control, should be emphasized. We should pay attention to the basic concept of practicality, cultivate the hands-on operation ability of police graduates, explore the realization path of smart education to reconstruct the education ecology, and utilize smart education to promote the digitalization and modernization of the educational means of the course. Centering on the training goal of the police master program to nurture professional police talents, a practical training (experiment) program is established based on scientific principles.

Third, the curriculum content should be constructed from a novel superior perspective. The course content must be modified in line with the smart education-integrated course design. With crime and police

theory as the core content, an information (big data) module is added on the basis of the four existing modules: introduction to criminology, crime phenomenon, crime causes, and crime prevention and control. Legal AI and big data systems hold far more cases than a single person, and the ability of AI to retrieve, analyze, and extract facts; analyze legal relationships; and predict judicial decisions is also unparalleled by a normal human being [3]. We should focus on improving the "innovation" of the course content and digitalizing the updated teaching cases. Through the smart education service platform, the public security network decryption materials, local journal resources, foreign police actual combat materials. and other contents can be introduced to constantly enrich the course content and expand the scope of cases.

3.3. Ensuring the construction quality of smart education projects

First, smart assessment should be taken as the starting point to lay a solid foundation for quality construction. On the one hand, we should strengthen the supervision of teachers. Teachers are faced with broad challenges brought on by smart education. These challenges are reflected not only in the comprehensiveness and depth of knowledge, but also in information acquisition and data analysis and processing. On the other hand, we should pay attention to curriculum supervision and management as well as information interaction and sharing. The original evaluation materials should be kept up to date, on-target, and complete so as to improve the teaching effect and evaluation system, while providing reference for other teachers. At the same time, we should pay attention to using big data for online teaching and learning, strengthen the supervision of the whole process, and promote the digital transformation of the evaluation system.

Second, a scientific and measurable curriculum evaluation system should be established. Teaching and examination should be separated based on the smart assessment platform. The smart assessment process highlights classroom performance and practice and establishes a diversified evaluation system that takes into account of regular assessment, homework assessment, mid-term test, and final examination. Teachers must inform the students of the evaluation methods at the beginning of the course and conduct the assessment with the aid of the smart assessment platform. Williams proposed a distributed degree evaluation system integrating blockchain, AI, and big data to focus on students' overall development [10]. This would help cultivate students' comprehensive ability and thinking in handling complex criminal cases when practicing in a risk society.

Third, the support and optimization of teaching and learning should be strengthened with technical support. Through the reconstruction of a series of links such as education model, education governance, education content, education evaluation, teaching methods, and so on by information technology, a new education ecology based on smart education can be created. Especially in the field of information security and encryption, we should strengthen the technical breakthrough and operation management in smart education to ensure the information security as much as possible. A new method based on cloud and recommendation system can be introduced to recommend interesting and useful books to students. This approach allows readers not only to rate the borrowed books, but also receive book recommendations based on the historical data stored in the cloud. The whole suite of systems may benefit readers as they are time-saving and cost-effective. In addition, if conditions permit, students should be encouraged and guided to use intelligent tools, such as ChatGPT and ERNIE Bot, to raise the classroom intelligence level.

3.4. Raising funds for smart education construction from various sources

There are several studies on investment and valuation of smart education in academic circles. Objectively speaking, the strength and intensity of investments are closely related to the success or failure of smart education. According to Omonayajo, the cost of using smart education technologies in the education system is quite low; although the expense incurred to the municipality from implementing new technologies can be high, computers, tablets, and class materials for students are inexpensive [12]. A number of scholars

believe that the construction investment by means of financial investment consumes a considerable sum of money, takes a long time, and may face investment risks. Karimanzira and Rauschenbach hold that multiagent collaborations in a "local area" network between mobile operators and information and communication technology (ICT) enterprises should be adopted in the construction of a smart education ecology. Since there is no network standard, it will be difficult to achieve system integration of multiple ICT subjects when considering the establishment of a credit system in the later stage. This will lead to several problems, such as high cost and a weak credit system [13].

The design, research and development, upgrade, and maintenance of smart education software require a certain amount of investment. The updating, purchasing, installing, and maintaining of hardware are huge expenses. These cost factors must be taken seriously by the implementing body. It is difficult for the government, enterprises, and higher education institutions to bear the huge one-time investment. In the process of promoting the smart education module, gradual investment and decentralized investment can be adopted to include the government, enterprises, actual public security combat departments, higher education institutions, alumni donations, social funds, *etc*. into the financing category.

4. Conclusion

The ultimate goal of technological development is to serve people, and it is impossible to separate the theory and practice of smart education from this attribute. As a high-end form of education system, smart campus has deployed cutting-edge information and communication technologies to improve the effectiveness and efficiency of campus services [14]. The construction of smart education in graduate programs is a long-term process. Even in short term, problems such as the poor cognition of smart education among teachers and students, the inadequate hardware and technical support, and the high pressure of financing have emerged. Looking forward to the future, with the support of smart education planning and design, process supervision and management, construction quality assurance, and funding guarantee, smart education will better promote the development of graduate classroom construction.

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Author contributions

This article was completed by M.C. independently.

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Challenges and Countermeasures in the Teaching of Engineering Mechanics in Vocational Colleges

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Abstract: Engineering mechanics is as a basic course, and the learning effect of this course directly affects the learning of subsequent professional courses. However, the teaching quality of engineering mechanics in vocational colleges has been subpar for a long time. In this study, we explored the teaching situation of engineering mechanics by using questionnaires, pointing out the challenges faced in the teaching of engineering mechanics and putting forward four targeted suggestions, which include stimulating students' interest and increasing the investment in laboratory equipment, to improve the teaching quality. The findings of this study may provide some reference for the teaching reform of engineering mechanics.

Keywords: Engineering mechanics; Vocational college; Teaching; Countermeasures

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1. Introduction

Engineering mechanics is a compulsory basic course for certain majors, including mechanical engineering, electrical power engineering, rail transport, *etc*. The learning effect of this course will directly affect the learning of subsequent courses, such as mechanical design, mechanical manufacturing, automatic control, hydraulics and transmission, *etc*. [1]. At present, most of the teaching contents of engineering mechanics in vocational colleges and universities are based on those used in undergraduate colleges and universities; hence, they lack certain vocational education characteristics. The abstract concepts and complex formulas in mechanics engineering are the important features in the teaching of this course. Most of the solutions in after-school assignments require students to employ mathematical calculations, which is precisely their weak point [2]. In addition, students often lack internship experience in enterprises and do not understand the dynamics of mechanical equipment, both of which lead to their ignorance of the purpose and importance of learning engineering mechanics. In short, the issue of poor teaching quality in vocational institutions continues to persist. Teachers generally feel that the teaching work is stressful and challenging, while students feel that the course itself is difficult, without much enthusiasm for learning [3].

In order to improve the teaching quality of engineering mechanics, a study was conducted. We first reviewed previous studies and investigated the teaching quality of engineering mechanics through a questionnaire survey. We then analyzed the challenges in the teaching of engineering mechanics. Through our analysis, several targeted suggestions are provided. The findings of this study may provide some reference for the teaching reform and innovation of engineering mechanics in vocational colleges.

2. Research status

The poor teaching quality of engineering mechanics in vocational colleges has been an existing problem,

and much research has been conducted on this subject. Jiao [4] applied the split-Hopkinson pressure bar (SHPB) apparatus to an experimental teaching of engineering mechanics for mining majors. The results showed that the integration of the preamble technology into classroom teaching is feasible and is conducive to improving students' comprehensive quality and innovation ability. Yue [5] proposed a teaching model integrating polymer specialization with engineering mechanics. This teaching model not only helped students understand the relevance of the course and professional knowledge, but also enhanced their learning interest and efficiency. Chen [6] proposed an "online and offline" hybrid teaching model based on the Learning Pass platform in response to the impact of the epidemic on teaching. After reorganizing the teaching content, he conducted a study in actual classroom practice. The results showed that this blended teaching model met the learning needs of different learners and effectively stimulated their interest in learning. Zhao [7] implemented a teaching practice oriented to professional certification. He built a teaching model based on "technology needs" to address the problems faced in teaching engineering mechanics. The study showed that the model was well received by both students and teachers. Su [8] discussed the reform measures of engineering mechanics teaching methods from the perspective of training programs for engineering majors and advocated that these measures could improve students' interest and enthusiasm for learning as well as cultivate their ability to analyze and solve mechanics problems. Zhu [9] pointed out the problems in teaching engineering mechanics through an analysis of the current learning situation and proposed a teaching method oriented to engineering ability with the goal of improving students' comprehensive ability according to the requirements of talent training in the context of "new engineering." This teaching model has been used in experiments with evidence of good outcomes. Yu [10] established an "online and offline" hybrid teaching mode based on the Learning Pass platform from three aspects: guided inquiry before class, feedback and question-answer during class, and extended training after class. He found that this teaching mode not only improves the teaching quality of the engineering mechanics course, but also enhances students' autonomy and enthusiasm for learning. Chen [11] proposed the integration of "character education" into the teaching of engineering mechanics, suggesting that teachers should rely on their own character to influence students, while continuously enriching the teaching content. Lu [12] explored the teaching of engineering mechanics with "problem discussion" as the focus. Through teaching practice, this method has shown to be effective in cultivating students' interest and improving their ability in analyzing problems. Zhang [13] analyzed the requirements for application-oriented professionals in the new era. Taking the concept of strain as an example, he introduced the finite element method in his teaching. The results of the study showed that the students understood the concepts of stress and strain more easily and the teaching effect significantly improved.

3. Teaching quality survey

Drawing on the results of previous researchers, we investigated the teaching of engineering mechanics from five domains: teaching content, teaching style, learning interest, interactive effect, and practical class. A survey was conducted on 71 students from two classes of mechanical engineering major. The questionnaire included five statements.

S1: I am satisfied with the current teaching content.
S2: I am satisfied with the current teaching style.
S3: I am very interested to learn in class.
S4: Classroom interaction has been very effective.
S5: I am satisfied with the proportion of practical classes.

The results of the survey were tallied, as shown in **Table 1**. In general, the students were not satisfied with the current teaching content and teaching style. Only 8 students agreed and strongly agreed with S1, while only 7 students agreed and strongly agreed with S2. Only 6 students (8.45%) agreed with S3, having

the least number of agreeable votes. Comparatively speaking, the effectiveness of classroom interaction received the highest number of agreeable votes, with 27 votes (38.03%). For S5, there were 20 agreeable votes (28.17%). This shows that the proportion of practical classes are not up to the students' expectation. Compared with traditional classroom teaching, practical classes in mechanics can attract students' interest; thus, they should be given more attention. In short, the results of the survey showed that the teaching quality of engineering mechanics is poor, thereby necessitating the exploration of new teaching modes.

Table 1. Teaching quality of engineering mechanics

Statement	Total sample	Strongly agree	Agree	Oppose	Strongly oppose	Invalid
S1	71	5	3	40	21	2
S2	71	3	4	41	20	3
S3	71	0	6	40	23	2
S4	71	8	19	23	18	3
S5	71	5	15	30	19	2

4. Challenges

4.1. Dry and abstract knowledge

The mastery of basic knowledge is the fundamental condition to learn engineering mechanics well. Compared with students in ordinary undergraduate schools, students in vocational colleges are not fond of learning theoretical knowledge and memorizing formulas. Unfortunately, in engineering mechanics, there are plenty of abstract theoretical knowledge and complicated formulas to be learned. Hence, engineering mechanics is often perceived as a difficult course even from the very beginning, and it is common to see students very willingly giving up the course. Taking the concept of stress in mechanics as an example, students tend to have a hard time understanding the concept since stress is intangible. In the examples and questions given by teachers, students are often faced with many knowledge points and formulas that are difficult to understand. This would eventually affect the students' motivation and interest to learn.

4.2. Lack of practical examinations

Compared with ordinary undergraduate institutions, vocational colleges are orientated to supplying skilled talents to the society. Therefore, it is very important for students in vocational colleges to develop their practical skills before stepping into the workforce. Engineering mechanics is a course that focuses on knowledge application. Hence, its assessment should focus on evaluating students' practical ability. With such a focus, students would be able to solve mechanics-related problems when they encounter them in the future. Unfortunately, the examination is still based on written tests, with little emphasis on practical examinations. As a result, students lack the opportunity to perform hands-on experiments and consolidate what they have learned. This will further lead to the lack of motivation and low learning efficiency among students.

5. Targeted suggestions

5.1. Using multiple teaching modes

With the rapid development of technology, multimedia has been adopted by many teachers for lectures. Such lectures aid in revealing certain geometric relations that are difficult to understand. For example, the geometric relationship of circular torsion (deformation diagram) can be clearly shown on PowerPoint (PPT) slides. However, PPT is ineffective when complex formula derivation and calculation are required. In such cases, teachers can opt for the traditional blackboard teaching mode. This mode enables teachers to write

on the blackboard while talking, which may be easier to retain students' attention. In short, teachers should select appropriate teaching modes and consider combining multimedia teaching with blackboard teaching. For more abstract concepts, multimedia can be used as the main teaching mode; however, when it comes to complicated formula derivations, teachers should consider using the blackboard as the main teaching mode with multimedia as a supplement. This organic combination of teaching modes not only improves the efficiency of teaching, but also enlivens the lesson.

5.2. Paying attention to students' calculation skills

As mentioned earlier, engineering mechanics involves many formulas, and many calculations may be needed to solve a difficult problem. If a student does not possess adept calculation skills, he or she may not be able to solve certain problems even if he or she knows the formula by heart. Therefore, it is necessary for teachers to help students review and consolidate basic calculations, including calculus and matrices, in their lessons. It is a seemingly simple, but effective, method to take students step-by-step through the calculation process with a typical example as a case study. It is necessary for students to master some common solution methods. In addition, teachers should consider printing out some common problems and distributing them to the students for self-learning. Students will also be able to exercise their abstract thinking and logical thinking abilities as their calculation skills improve. All these abilities are important for students to learn engineering mechanics and also to solve mechanics problems in their future work.

5.3. Introducing new technologies into the classroom

The rapid development of technology has provided a thrust for educational innovation. New technologies such as "Internet +," modeling simulation, animation production, *etc*. have brought great convenience to the teaching reform of engineering mechanics. Taking finite element simulation as an example, teachers can generate stress cloud diagram and animation through modeling and simulation calculations. These digital materials are very convenient for students to understand abstract concepts, such as stress distribution and stress concentration. The results from the analyses can be used during lessons to increase students' interest and motivation. In addition, students can also consult various materials to modify the models in class, which will also benefit students in developing their self-learning ability.

6. Conclusions

Engineering mechanics is a compulsory basic course for mechanical engineering, electrical power engineering, construction, transportation, metallurgy, and other majors. The learning effect of engineering mechanics will directly affect the learning of subsequent professional courses. At present, the teaching of engineering mechanics in vocational colleges is faced with various challenges. Based on the review of previous research results, four targeted suggestions are proposed. In terms of student training, we suggest to focus on stimulating students' interest in learning and helping them improve their calculation skills. In terms of teaching mode, we propose the combination of multimedia and blackboard, along with the introduction of new technologies into the classroom. The findings of this study may provide some reference for the teaching reform of engineering mechanics.

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Disclosure statement

The authors declare no conflict of interest.

Author contributions

S.W. and F.P. conceived the idea of the study and wrote the first draft of the paper. B.C. revised the format of the article.

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Research on College English Classroom Construction Based on Semantic Wave

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Abstract: In this paper, the influence of English teaching methods and teachers' behaviors on students' learning in China is discussed. Through analysis, it is found that classroom discourse practice plays a significant role in teaching plan and teaching content. Therefore, in the research based on discourse practice and belief, a college English classroom promotion model is constructed from the perspective of semantic wave based on three dimensions (individual factors, situational factors, and overall factors), providing a scientific basis for the development of college English teaching in China and a valuable reference for curriculum reform and teaching plan formulation.

Keywords: English classroom discourse practice and belief; Semantic wave

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1. Introduction

In China, in order to improve the level of English teaching, many attempts have been made to introduce, develop, and integrate various teaching methods. The English teaching methods in China have been greatly developed. These include grammar-translation, listening and speaking (communication), task-based teaching, and mixed teaching. The research and discussion on teaching methods among teachers have been refined from methodology to teachers' behavior. These research directions mainly focus on two aspects: "Why do teachers behave in such a way?" and "What influence their behaviors have on students' learning?" [1]. From the basic concept of speech act, we may find that speech is, in fact, an activity with rich connotation, reflecting the interactions among language, reality, and personal understanding. Therefore, the best way for teachers to demonstrate their personalized teaching methods is to imbue themselves with the local culture. In classroom display, the problem of classroom discourse is the focus of teaching plan and the information transmission of teaching content.

English teacher's classroom discourse refers to a specific discourse decision-making process and a realistic discourse constructed by an English teacher in a specific educational situation according to various theories [2]. From the perspective of language, it can be seen that classroom discourse not only displays strong individual characteristics, but also reflects its social and cultural background on the basis of improving educational methods. Therefore, in order to thoroughly understand the logic of language classroom discourse practice, it is necessary to analyze and clarify the relationship between English teachers' discourse practice and discourse belief in English teaching from the perspective of semantic wave and social and cultural background.

This paper discusses the role between college English discourse practice and belief and teachers' classroom discourse practice from the perspective of semantic wave; a college English classroom

promotion model is then constructed, and both English education and teachers' growth are analyzed from three dimensions (individual factors, situational factors, and overall factors) so as to provide a scientific basis for the development of college English teaching in China. The study of teachers' classroom discourse practice from a dialectical and critical perspective may deepen the understanding of both teachers and educational administrators about the logic of English classroom practice, provide some ideas for college English classroom construction, and offer valuable reference for college English curriculum reform and teaching plan formulation.

2. Operation logic of semantic wave in college English classroom discourse

Semantic wave is a method of accumulating knowledge and also the key to the changes in semantic gravity and semantic density, both of which are closely related [3]. Through cumulative knowledge-building, students can transfer what they have learned to future context under existing cognition so that the knowledge of each major will be closely linked to their own background knowledge, thus deepening their understanding of what they have learned.

In this paper, college English classroom is selected as the topic, and issue of how to use classroom discourse practice in college English teaching is discussed. In classroom discourse, teachers realize the construction of their understanding of themselves, others, language, teaching, situation, and society and output the expression of their classroom discourse on this basis. On the one hand, it reveals the teacher's understanding and influence on language, text, teaching, students, and the social and cultural environment [4]. On the other hand, it enhances students' understanding of reading and writing.

Semantic wave is considered a prerequisite for cumulative knowledge-building. In college English class, teachers "unpack" highly abstract and technical theories and deconstruct them through examples and situations. Through that, knowledge is constructed and "repackaged." The knowledge generated by examples and situations is accumulated and eventually abstracted into concise theories. By summarizing objective matters and reasoning actual ones, "rational" knowledge construction transpires. On the basis of knowledge construction, abstract and concise theories are transmitted [5]. This is the idealized logic of college English teaching. However, in real life, not every teacher can control his/her classroom discourse well although semantic waves are well-controlled. Since teachers are social individuals, they possess unique characteristics in social cognition and cognitive orientation. Each teacher has different personal experiences and understandings of the same matter. When the discourse context taught integrates with the current social and cultural situation, new perceptual knowledge will be produced, which will have a great impact on the teaching of English knowledge. As a result, different teachers have different meanings and explanations for the same problem.

3. Characteristics and connotations of college English classroom discourse from the perspective of semantic wave

The classroom style of college English teachers corresponds to their own narrative style and discourse system. Since the teachers' own discourse practice is recognized and influenced by themselves, others, language, teaching, situation, and society, from the perspective of semantic wave, the key factor that affects semantic density and semantic gravity is the accumulation of knowledge. The accumulation of knowledge in English teaching is mainly manifested in reading and writing. Although there are some differences in the expression of these two components, they both construct a narrative system by changing the common ground of semantic density and semantic gravity, among which individual factors, situational factors, and macro factors have more pronounced influence on teachers' narrative curriculum discourse practice and may jointly influence teachers' individuation and creativity in classroom discourse. In this paper, the connotations of individual factors, situational factors, and macro factors are discussed, and their influences

on teachers' beliefs and practices in classroom discourse are analyzed.

3.1. Individual factors

Teachers' beliefs are closely related to their growth experience, education experience, and teaching experience. Their teaching, research, life, study, and other experiences have a significant impact on their beliefs and, to a certain degree, their teaching activities. In addition, the composition of individual factors is closely related to specific situations in addition to the social and cultural environment. This composition includes the "situation" and "reality" of individual factors. With the development of time, the "situation" and "reality" of individual factors have strong individual characteristics with the ontology of research objects. From the perspective of a timeline, the situational and macro factors described below are the specific educational situation and macro-social humanistic situation in which the "present" teachers are at. At the level of belief, although teachers actively construct their own classroom discourse, they still follow the "inertia" in discourse practice. This "inertia" has a significant relationship with teachers' past experiences. Survey results have shown that as people grow in different environments and have different learning and life experiences, there will be different educational methods and ideas as well as classroom speech beliefs. Therefore, the difference in teachers' personal life experiences will have a great influence on their thinking and decision in classroom discourse behavior.

3.2. Situational factors

Situational factors include campus culture, interpersonal relationships, and the system of teachers. These middle-level influencing factors also have an effect on teachers' education and development. Research has shown that schools that value teamwork and have more open cultural perspectives will obtain better outcomes more readily when participating in projects, whereas schools that practice relatively closed campus culture and prioritize personal development often do not achieve good outcomes. A collaborative campus culture is one of the necessary factors to promote teachers' development [6].

Although teachers may study in the same college or university, they will have different educational ideas due to the influence of external factors, such as their situation and individual differences. Therefore, even in the same situation, their cognitive level, as a whole, will show certain differences. These differences are derived from their experiences to a certain extent. However, as far as the data in this paper are concerned, among all the individual differences, the differences in teaching years and age are the main reasons for the different effects of situational factors. Compared with older teachers, new teachers have lower autonomy in education, and it is difficult for them to achieve full autonomy in their own classroom discourse design [7]. On the other hand, new teachers have higher social expectations and the desire to quickly adapt to the environment; hence, it is easier for them to reform the discourse design and practice in classroom teaching. However, this change has not affected teachers' discourse belief in classroom, leading to the lack of discourse power among new teachers. Therefore, concessions have been made, but they not only failed to promote teachers' growth, but also caused anxiety and fatigue among teachers.

3.3. Macro factors

According to data analysis, the major factors affecting classroom discourse at present include China's language education policy, standardized tests, social ideology, academic development, scientific and technological development, and so on [8]. According to investigations, from teachers' classroom discourse belief to the design and implementation of classroom discourse, they are all divorced from reality. This is consistent with the findings of previous investigations on teachers' educational behavior and concept. The contradiction between teachers' classroom discourse belief and the external and macro environment renders the adjustment of classroom discourse design, which is reflected in actual situations and consistent with

previous studies on teaching beliefs [9]. According to literature, their previous life, learning, teaching, and research experiences, along with current national policies and social thoughts have a significant influence on their beliefs.

The challenges and pressures faced by foreign language teachers in classroom discourse practice are also closely related to the current speed and dimension of scientific and technological development. With the development of science and technology, teachers often make changes to their classroom discourse under different circumstances.

4. Suggestions for promoting high-quality English classroom teaching from the perspective of semantic wave

From the perspectives of semantic wave and the complexity of English teachers' classroom discourse expression, several suggestions are proposed to improve the quality of English classroom from three different levels: individual, situational, and macro.

4.1. Individual level

At the individual level, we should first focus on improving students' discourse knowledge literacy and language skill training. In this process, teachers should encourage students to actively deconstruct and reconstruct their own semantics and knowledge. At the same time, schools and teachers should provide students with a framework as guidance and direct their learning goals, respectively, so that they can achieve their learning goals. In addition, teachers should adjust their discourse density and meaning attraction according to the actual situation and teaching materials. The development of teachers' discourse ability should not be separated from the micro-details of discourse. Different discourse details have different functional, textual, and interpersonal potentials, and these potentialities have different effects on discourse learning. Since they have different effects on language learning, there are now higher requirements for teachers. Teachers would have to transform all kinds of educational materials and existing texts into discourse and learn how to make full use of online and offline resources to enrich their classroom discourse. Teachers should also include some multi-modal characteristics in their discourse. With the help of different senses, such as hearing, vision, and touch, using language, images, sounds, actions, and other methods and symbolic resources may be beneficial in helping teachers express and coordinate various modes of discourse so as to establish a complete set of discourse meanings.

4.2. Situational level

As a form of social construction, situations have certain effects on personal discourse, behavior, belief, and behavior, and these effects are produced by teachers' social intervention. Social construction is beneficial to the development of English teachers' classroom discourse. It is embodied in the following aspects: improving the materials of English-related education and research, carrying out effective management in English education and research activities, strengthening the support for English education and research, strengthening the growth of English teachers, improving the channels, perfecting the reward and punishment system, *etc*. As a key link in teachers' social network, higher education institutions develop close ties with the surrounding groups, communities, social culture, politics, and economy and form close interactions with each other, both of which play significant roles in the development of teachers' discourse ability. It is important for teachers and students to carry out educational research and learn English, respectively. Higher education institutions should build network supports for English teaching and scientific research in order to provide a comprehensive guarantee for college English teaching. They should also take the initiative to carry out educational research, introduce professional talents, hold reports and workshops all year round, establish learning programs for teachers based on network and mobile technology

with excellent universities at home and abroad, encourage foreign language teachers to participate in scientific research and continue their studies, and give priority to educational evaluation and professional title evaluation. Under the impetus for educational reform, there have been gradual changes to outdated educational ideas, teaching has been advocated to drive research, and vice versa; and the latest theories, teaching methods, and technologies have been applied in English teaching.

4.3. Macro level

From a macro perspective, China's education reform often centers around the "top-down" model. If profound and significant changes are bound to occur, a good foundation and development direction is required. The influence of the state and society on college English classroom discourse is relatively subtle. In other words, the relevant language policies of the state and social ideology have a great influence on teachers' classroom discourse.

The College English Curriculum Requirements clearly states, "College English is not only a foreign language course about basic English knowledge, but also a course that helps students to broaden horizons and learn about different cultures, that is, to improve their comprehensive cultural quality." It has both "instrumental" and "humanistic" functions [10]. Therefore, in the teaching of college English, it is necessary to have solid basic knowledge of English in order to improve students' knowledge about the language. In addition, our language education decision-making organs and departments should have a clear focus. Paying too much attention to the instrumentality and professionalism of English may lead to negative influences, such as overspecialization and utilitarianism of English. The basic purpose and content of college English education should be to integrate general education into the thought of college English education and humanities with natural sciences. Promoting English as the carrier of life practice to improve the language level of college students and a necessary language for global citizens should be the fundamental goal. It is necessary to emphasize on knowledge learning, along with the idea of all-round development, so as to improve humanism and scientism in students.

Disclosure statement

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Research on Online Teaching and Offline Course Construction for Power Electronics

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Abstract: Due to the impact of the novel coronavirus outbreak, universities have adopted online teaching and carried out remote teaching. With the improvement of the epidemic and the approaching of the new school year, the organic connection between online teaching during the epidemic and offline course construction after the epidemic is not only a challenge for tertiary education teachers, but also an urgent issue to be addressed. Therefore, the power electronics course is taken as an example to explore this connection.

Keywords: Power electronics; Online teaching; Course construction

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1. Introduction

At the end of 2019, there was an outbreak of a serious infectious disease caused by the novel coronavirus (2019-nCov), which spread from Wuhan to countries all around the world. All nations, including China, are currently fighting against this novel coronavirus pneumonia [1]. In order to stop the spread on campus and ensure the safety and health of both students and teachers, the start of the 2020 spring semester was postponed in all universities. In response to the impact of the epidemic on normal classes and classroom teaching in higher education institutions, the Ministry of Education (MOE) issued the "Guidelines on the Organization and Management of Online Teaching in General Higher Education Institutions During the Prevention and Control of the Epidemic" on February 4, 2020, requiring these institutions to make full use of online courses and high-quality online teaching resources at provincial and university levels [2] as well as to rely on various online course platforms and learning spaces at all levels to actively carry out online teaching activities, including online lectures and online learning, thus ensuring the progress and quality of teaching during the prevention and control period and realizing the effort of "suspending classes without stopping learning" [3].

Faced with the sudden variable of the epidemic, various universities have adopted online teaching platforms for emergency purposes, guiding university students through online platforms; furthermore, teachers of various disciplines have begun to use various online tools for distance learning [4]. Online teaching during the outbreak and curriculum development after the epidemic present a double test for these teachers. In the present study, the "Power Electronics" course was taken as an example to explore the organic connection between online teaching during the epidemic and course construction after the epidemic.

1.1. Course characteristics as the determinant of the method of delivery

In view of the different nature of each course, each course should be taught using a delivery method appropriate to the course. Teaching methods used, whether online or offline, the teaching strategies, and the content of the course are determined by the characteristics of the course.

Power electronics is a compulsory course for electrical engineering and automation majors. It is highly practical and has a short iterative technology cycle [5]. In addition, it carries significance in the curriculum of all majors. The course is highly theoretical, and its content is relatively obscure [6]. The concepts are complex and difficult to understand; thus, many students have a poor foundation. In addition to that, the class size is often large, with some majors comprising up to 200 people in a class.

Power electronics is an emerging technology covering three disciplines: electricity, control, and electronics. It is a compulsory core professional foundation course for electrical engineering and automation majors [7]. The course is offered in the first semester of the third year of university, with a total of 56 hours, which include 40 hours of theoretical study and 16 hours of practical learning. This course considers the knowledge of power electronics as the basis and focuses on two cores: power electronic components and power electronic circuits. The basic principles of power electronic circuits, control methods, application methods, and other contents are taught in this course. The course content is divided into four modules, namely power electronic devices, power electronic circuits, pulse width modulation (PWM) control technology, and applications of power electronic devices. The first module is the foundation of the course, the second and third modules are the main body of the course, and the fourth module is the depth of knowledge of the course.

The standards of the course, which define the competence and knowledge objectives to be achievable by students at a high level, present quality objectives with rich ideological elements [8]. The overall training objectives are as follows: enable students to master the characteristics of power electronics devices so as to develop the ability to select devices; enable students to master the ability to analyze circuits, outline the working principles of circuits, analyze the output waveforms of circuits, and understand the transformation process of electrical energy; enable students to understand the scope of application of technology in this field and its development trends as well as to establish a comprehensive knowledge system structure; develop students' ability to think independently, innovate, carry out scientific research, and climb up the ladder, as well as love their country and family in order to strengthen the country's technological strength. The objectives of the course consist of knowledge objectives, competence objectives, and quality objectives.

(i) Knowledge objectives

Appreciate the basic knowledge and concepts of power electronic devices; familiarize with the structure, operating principles, and calculations of various power electronic circuits; understand PWM control methods.

(ii) Competency objectives

Develop the ability to select devices, analyze circuit structures, and analyze circuit waveforms; solve typical applications of power electronics in commonly used electrical energy converters.

(iii) Quality objectives

Develop a scientific attitude of seeking truth from facts, a working style of exploration, and a spirit of innovation; cultivate scientific aesthetic and strive to discover the intrinsic laws of relevant professional courses; cultivate the ability to learn independently and firmly establish a dialectical materialist worldview.

Local universities adopt the "serial" curriculum structure of basic courses [9], professional basic courses, and professional courses, with each course forming a relatively complete but closed teaching system. The same objects of research, such as devices and modules, are often observed in various courses, focusing only on their application in the course instead of the interconnection and extension of the content of each course

from the perspective of engineering practice. As a result, students are unable to develop systematic awareness of circuits, their knowledge becomes more fragmented, and they are less able to relate one idea to another. An exciting theoretical teaching process not only allows students to better grasp professional knowledge, but also stimulates their motivation and professional interest, encouraging them to engage in practical, in-depth practice, promoting the concepts of action with knowledge and seeking knowledge with action, as well as paving the way for practical teaching.

When it comes to specific knowledge from related courses, the courses are combined to review what has already been learned and re-explain it. Only with a profound understanding of the basics and the ability to integrate them can students appreciate the true meaning of rectifier and inverter parameters and analyze waveforms and phase change points independently. For example, before explaining about rectifier circuits and three-phase controlled rectifier circuits, the average and root mean square (rms) calculations as well as three-phase circuits are reviewed. In view of the link between this course and other courses, the summary and emphasis of specific knowledge points when constructing the course would lay a solid foundation for students to successfully learn this course.

2. Selection methods of teaching modes during the epidemic

The outbreak was an unexpected event, and online teaching was encouraged to minimize the impact of such an event. In essence, there are too many differences between online teaching and conventional classrooms. Both teachers and students may be affected by the changes to the environment in which they take lessons. If the methods and approaches used in online teaching are not chosen properly, they can affect the quality of teaching and talent development. The nature and characteristics of the course determine the mode of online education. The teaching requirements, syllabus, talent training objectives, *etc*. should be first clarified. Thereafter, it is necessary to be familiar with the available online teaching platforms and choose one or more online platforms that are suitable for the course.

Information-based teaching is not a technology [10], let alone a tool [11]; it is simply a change in teaching. Online teaching should not be technology-oriented and hardware-orientated, but rather teaching-oriented and software-oriented. It is not simply a matter of completing teaching tasks and carrying out lessons online, much less purchasing a bunch of hardware. At the heart of online teaching lies a change in teaching philosophy.

With regard to the curriculum, for courses related to programming language, there are many interactive perspectives [12], and at special times like the epidemic, live courses may be suitable. In such settings, students are led to intersperse the implementation of program code with the explanation of knowledge points. Students may find it easier to understand such online courses. As the course progresses, the functions implemented become more varied and interesting, thus enhancing students' interest in learning and motivating them to learn. For courses with abstract knowledge and obscure concepts, online courses that are identical to the course textbook and teaching content can be found on various online platforms, such as China MooTools, during the epidemic. Students are encouraged to learn theoretical knowledge first in class according to the teacher's rhythm; after a lesson or two, the teacher conducts a live class and interacts with the students to understand the difficulties they encounter and address them. The teacher then shares common real-life cases involving relevant course content to consolidate their knowledge and stimulate students' interest in learning.

According to the characteristics of the course, China University Massive Open Online Course website is used for online teaching, and the power electronics course offered by Fujian Engineering College is selected, taken as an online resource, and recommended to students. In view of the similarity between the online resource and the textbook and teaching content, the online resource is assumed as the teaching resource. Moreover, the video materials, course handouts, post-course quizzes, and examination system are

ideal, the basic knowledge points are complete, and the learning management is convenient for online learning. After the students have learned two or three sections, a live interaction using online platforms such as Tencent conference and Zoom is carried out. The purpose of this interaction is, firstly, to strengthen students' understanding of knowledge points through problem orientation, develop their ability to apply knowledge, scientific research awareness, and scientific literacy, as well as improve students' self-learning ability and awareness for active learning; secondly, to emphasize key elements; and, thirdly, to provide common examples in life, concretize abstract problems, visualize boring problems, and make uninteresting problems vivid.

For example, in the first interactive live session, the teacher provides the textbook definition of power electronics, *i.e.*, a technology of transforming and controlling electrical energy using power electronics, and Wilson's definition of power electronics, *i.e.*, a technology that efficiently transforms, controls, and regulates electrical energy by static means, so as to change the form of input power into the desired form of output power [13]. The teacher then asks, "What is the transformation and control of electrical energy?", "What is the form of power that can be obtained?", and "What is the desired form of power?". Following that, students are actively guided to use what they have learned from the Massive Open Online Course platform to answer the questions. However, due to the large number of students in class, the network can be a little laggy. The teacher interacts with the students at times, acting like a webhost, saying things like if you can understand, type "1"; if you have doubts, type "2"; if you do not understand at all, type "3." At this point, we will see a rapid data growth in the chat box. This kind of live interaction is "alive." It is not just a lecture, where one side may be listening intently, whereas the other may be doing something unrelated to the course due to boredom or poor understanding. A classroom without interaction is a classroom without "life". Other than that, examples of mobile phone charging and electric drives for high-speed trains are used to illustrate the source of power supply and the need for energy conversion. This kind of interactive live broadcast is what makes an effective live broadcast, allowing both teachers and students to sense each other's presence and interact with each other even when they are at opposite ends of the network.

The need for online teaching at special times is not a requirement for all classes to be broadcast live [14]. The online platform is merely a tool for information transfer [15], whereas the teaching methods and approaches continue to be the core of any lesson. The constraints of space and distance make it challenging to control and direct the teaching process if knowledge is simply imparted, teachers simply instruct, and students simply listen, Teaching is about people, and the message of teaching is not only about knowledge, but also about the teacher's exploration and understanding of the issues involved as well as the teacher's emotions and teaching style. The transfer from physical classrooms to online videos involves a multifaceted adjustment of the teaching content, teaching framework, and teaching style; a commitment to a combination of teaching principles; and an attempt to adopt a variety of teaching methods in a flexible manner [2]. Teaching design resides at the heart of teaching and learning. Teaching design should be different at different times using different teaching methods. Carrying out in-depth research on teaching and learning is the prerequisite for teaching design. Only with thorough research can we understand the problem and develop a problem-oriented teaching design with a certain degree of challenge. With the advancement of information technology tools and the temptation that comes with them, teaching design is important regardless of the context. The goal of intellectual innovation has to be achieved through interactive question-and-answer sessions.

In the interactive process, teachers can use common, concrete, and interesting practical examples to stimulate students' interest in learning. For example, in power electronics, practical examples from factories, such as the beer production process and paper production monitoring system, can be used, along with materials from student competitions and circuit designs from outstanding graduation designs; in addition, research projects can also be integrated into specific examples, such as medical robots and drones. These

are all areas of interest to students. Interest is what enlivens a class, and, by using interesting examples to attract the attention of students, classes will be much more effective.

There are other online resources that enable students to find solutions to difficult problems in a timely manner. During the epidemic, when students encountered difficulties, the teachers encouraged them to solve the problems on their own to help develop their problem-solving skills. The solutions can be any appropriate suggestions from forums, course knowledge obtained by asking in WeChat groups or QQ groups, or the network platforms of other schools with relevant knowledge points. The teachers then designed specific questionnaires and sent them to the students via the QQ groups. Through the questionnaires, they used the data to analyze the learning situation of students, adjust the teaching methods and contents in time, and continue exploring and reforming, so as to develop a more mature online teaching mode.

3. Curriculum construction in the aftermath of the epidemic

In the aftermath of the epidemic, university students returned to school. The means of testing prior knowledge, the methods of imparting subsequent knowledge, and the final test are all key elements of our exploration and research. These elements are closely linked to the nature and characteristics of the course and the teaching methods used during the epidemic.

After the epidemic, the power electronics course should be constructed with special periods of online teaching to achieve seamless integration of knowledge. In subsequent courses, the advantage of information-based teaching as a booster of conventional classrooms should be upheld so that students can consolidate and understand previous knowledge points while learning new ones and eventually achieve the integration of the two. The course also aims at developing students' ability to adapt to the society and improving their literacy so as to truly train talents for the society.

3.1. Theory lessons

Students are allowed to watch instructional videos from the university's platform, with some time shift, from in-class to out-of-class. The in-class sessions are used for discussion. Considering the large class size, students are divided into 20 groups and allowed to form their own QQ or WeChat groups, with around 10 students in each group. After dividing into groups, the first question is given, and the students will have to discuss it in their own groups. The discussion is then carried out depending on the students themselves, either via typing or verbally. If the discussion is carried out verbally, the volume is adjusted in such a way that it does not affect other groups of students and the teaching in other classes. When the time is up, each group will choose one representative to explain, while the others would add to it. Thereafter, the teacher and the students from other groups can direct questions to that group. Each student is given a benchmark score for this process, with appropriate marks added for accuracy and motivation. The topics discussed mainly concern analysis of basic knowledge and analysis of circuit parameters, and they can be based on investigations of basic knowledge, discussions using case studies, *etc*.

3.2. Practical sessions

For engineering students, practical sessions are constructed on the basis of theoretical classes, with the aim of enabling students to understand, consolidate, and apply theoretical knowledge through practical sessions. During the epidemic, there are too many limitations to carry out practical sessions at home, except for programming classes. After the epidemic, practical classes are arranged according to the progress of the teaching content.

Power electronics has eight practical sessions according to the Talent Development Program, which are scheduled against the progression of the basic content. There are seven experiments and one course

design. Due to the epidemic, the single course design increased to three and was changed to a collaborative group effort instead of individual design. The grouping is consistent with the grouping in theoretical class discussions. The course design is taken as the final experiment, without any reduction in the number of previous experiments. Both the basic experiments and the simulation experiments lay the foundation for the course design. Basic experiments encourage students to design their own experimental schemes based on functional and performance indicators to create actual hardware circuits, while simulation experiments train students to better understand the control technology and implementation methods of conversion circuits through simulation software. Progressing from simple to complex, the course design cultivates students' teamwork spirit and ability to comprehensively apply the basic knowledge learned and establish engineering design ideas [3].

3.3. Civic education

The teaching of power electronics is objective and universal, focusing on the knowledge of power electronics [16]; the two cores, power electronic components and power electronic circuits [17]; and certain basic principles, including power electronic circuits, control methods, application methods, and other content. For decades, "ideology and politics" is not emphasized in the teaching of power electronics. Rather, the course focuses on the transmission of knowledge, the cultivation of "talents," and the use of "tools"; very little consideration has been given to the education of "people" and "morality." The teaching content, teaching design, and teaching methods for "ideology and politics" are all lacking. It is difficult to form a synergistic effect with civic science because of the preparation of teaching contents, design of teaching links, and research on teaching methods. At the same time, the target students of power electronics are those majoring in electrical engineering and automation, who generally have more technical knowledge but less social sentiment. Hence, there is an urgent need to enhance students' national sentiment and political commitment in the course.

Integrating civic education into the teaching process should be guided by the "Thought on Socialism with Chinese Characteristics for a New Era" and the goals of cultivating respect among students for scientific knowledge [18], forming a rigorous learning culture among students, establishing in students a correct outlook on life and values, strengthening students' responsibility of the times, historical mission, and dedication in learning professional knowledge, ensuring that students make due contributions to the construction of socialism with Chinese characteristics for the new era, and laying a good professional ethical quality among students for future technical work related to electrical engineering and other fields.

According to the teaching content, a mind map of knowledge points is drawn to build a seamless connection between knowledge points and the content of civics education, forming a student-centered, intellectual education-based, and moral education-supplemented professional curriculum system.

For example, after discussing all the variable current circuits of power electronics, students will be able to appreciate that power electronics, as an energy conversion technology, can be found everywhere. From the perspective of natural discernment, everything needs to be viewed in a discriminatory way [19]. As there are advantages to the development of power electronics, there must also be some disadvantages. For example, power electronics has been used by unscrupulous people to create destructive weapons, which have brought disaster to human life. In learning about technology, using it, and innovating it, students should strive to reduce the negative aspects, attempt to make favorable contributions to the progress of the society and the development of mankind, respect nature, and follow its laws. Students should be guided to think dialectically, not only in the face of technological development, but also in every aspect of their lives, be it in their studies or analyses of current events.

Power electronics is not only about students learning theoretical concepts [20], but also about their practical skills. Based on the training objectives, seven learning projects have been designed with key

knowledge points as elements to reconstruct the course content, expand students' horizons for application, and enhance their practical skills. In the course of teaching, each project incorporates elements of ideology and politics into the teaching, which deepen students' understanding of professional knowledge application, and deeply explores the content of civics education embedded in professional knowledge and skills to organize teaching and improve students' professional quality, covering all aspects of literacy and actively promoting all-round development.

3.4. How grades are assessed

The conventional methods of assessing students' learning performance rely, for the most part, on the results of the final examination paper. The teaching methods used during the epidemic were in line with the nature and characteristics of the course. After the epidemic, they are based on the articulation of various contents. Students' learning process and practical skills should be part of the assessment; therefore, new and diverse assessment methods should be established. In information-based teaching, problem-oriented questioning reflects students' ability to learn independently, while discussion sessions in small groups reflect students' participation during lessons and their sense of teamwork; moreover, research methods and reports in practical modules reflect students' hands-on skills and ability to analyze and solve practical problems; random questioning in classroom through information technology tools reflects students' learning behavior. Using information technology tools to check the submission of assignments may help us determine students' learning effectiveness. In that way, we can make an objective assessment of students' learning attitude. It can be seen that these assessment methods can better reflect the overall quality of students.

In terms of the way grades are assessed, the teaching methods during the epidemic and the construction of the course after the epidemic are closely linked. A variety of teaching methods have been used to achieve the teaching objectives of power electronics, and exploratory reforms in teaching methods, teaching evaluation, and personnel training have been made. Special circumstances were encountered during the epidemic; however, there were no delays in the learning phase, especially in terms of accumulating knowledge, developing competence, upskilling, and improving engineering literacy.

4. Conclusion

The connection between online courses during the epidemic and courses after the epidemic is dependent on the characteristics of the course, the online delivery methods, the construction of online resources, the course planning after the epidemic, the way students are graded, and other factors. Exploring their organic connection is conducive to the timely adaptation of teaching methods in special periods and the complete integration of students' knowledge system.

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Disclosure statement

The author declares no conflict of interest.

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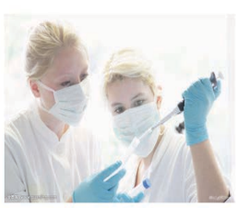

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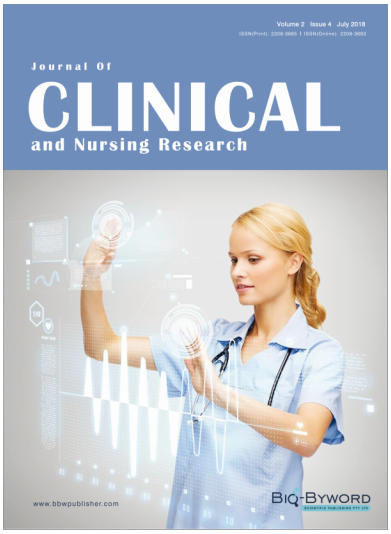

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