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International Education Forum

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Exploration of the Integration of STEM Education Concept into High School Biology Teaching

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Abstract: In China, STEM education is quietly emerging and has attracted extensive attention in the education field. As a new educational approach, it can not only fully mobilize students' enthusiasm for learning biology but also enrich classroom content, provide students with abundant learning resources, and enable them to explore biological knowledge independently. Currently, STEM education, which focuses on cultivating students' comprehensive qualities and innovative and creative abilities, has gradually become a trend in the reform of high school biology teaching methods. Therefore, the research on the integration of STEM and high school biology classrooms has important practical significance. This paper first briefly introduces the significance of integrating STEM and high school biology classrooms and then analyzes the effective strategies for this integration, aiming to provide new perspectives and methods for high school biology teaching, stimulate students' learning interests, improve the effectiveness of biology teaching, and inject new vitality into 21st-century STEM education.

Keywords: STEM education concept; High school biology; Teaching strategies

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1. Introduction

The current new curriculum reform has put forward the latest requirements for students' core qualities. In the past two years, the STEM education concept has gradually penetrated high school biology classrooms. The aim is to cultivate students' core qualities through cross-disciplinary integration, fully mobilize students' interest in learning biology, and promote their all-around development^[1]. However, some teachers have not fully mastered the specific methods for effectively integrating STEM education into biology classrooms. It is hoped that the research of this paper can provide useful references for high school biology teachers in implementing STEM education during actual biology teaching. At the same time, it can give full play to the educational function of STEM education in cultivating students' biological core qualities^[2].

2. The value of high school biology teaching based on the STEM education concept

The “STEM” education concept is a comprehensive education model that spans multiple disciplines such as science, technology, engineering, and biology. It especially emphasizes innovation, practice, and cross-disciplinary integration. In recent years, with the innovation of educational concepts, more and more educators have come to realize the significance of integrating STEM into high school biology classrooms ^[3].

Firstly, it helps to effectively enhance students’ interest in learning biology. Traditional biology teaching often relies on classroom explanations and practice exercises, lacking practical operations and real-world applications. Students’ understanding and memory of knowledge are often superficial, and they lack enthusiasm and interest in learning. However, STEM emphasizes practice, exploration, and innovation, encouraging students to understand biological knowledge through hands-on practice. This is not only conducive to cultivating students’ practical abilities but also can greatly enhance their interest in learning biology ^[4].

Secondly, it helps to deepen and broaden the scope of biology teaching. Biology is a highly theoretical and abstract subject that often requires high-level logical analysis ability for in-depth understanding. STEM emphasizes cross-disciplinary integration, enabling students to deeply experience the internal connections between biology and other disciplines such as science, technology, engineering, and art while learning biology, which is beneficial for deepening and broadening their learning ^[5].

Finally, it helps to cultivate students’ innovative thinking and innovative abilities. Influenced by STEM, the biology classroom is no longer just a place for imparting knowledge but rather a platform for students to practice, explore, and innovate. On this platform, students can not only understand biological knowledge more deeply through practical operations but also apply knowledge flexibly by solving real-world problems, thereby cultivating their innovative thinking and innovative abilities ^[6].

3. Analysis of the current situation and problems in high school biology teaching

3.1. Obvious textbook orientation

In terms of textbook orientation, the current high school biology textbooks have rigorous content design and strong systematicness, providing clear teaching objectives for teachers. However, the overly obvious textbook orientation also has certain limitations. On the one hand, excessive reliance on textbooks may lead to rigid classroom teaching activities, lacking flexibility and innovation, and failing to fully mobilize students’ initiative and creativity. On the other hand, the update speed of textbook content lags behind the needs of the times, and it may not be able to reflect biological problems in modern science and technology and real life in a timely manner, which is not conducive to cultivating students’ ability to solve practical problems and their cross-disciplinary literacy ^[7]. For a long time, teachers have been limited by such textbook content and tutoring materials, ignoring the importance of interesting teaching and students’ learning processes. This should be optimized in the reform of high school biology teaching oriented by core qualities.

3.2. Single and inflexible teaching model

The single and inflexible teaching model is another challenge facing current high school biology teaching. Many classrooms still use the traditional lecture-based teaching method, with teachers as the dominant force and students in a passive receiving position. This one-way indoctrination teaching method often ignores the dominant position of students and their personalized needs ^[8]. Although some schools have started to try new teaching models such as interactive and inquiry-based teaching, in actual operation, they still struggle to get

rid of the pressure of exam-oriented education. As a result, the implementation of these new models remains superficial and fails to fully utilize their potential to stimulate students' interests and cultivate their thinking abilities. In the future, teachers should embrace new concepts and new technologies and widely apply them in practice to truly improve students' enthusiasm for learning, cultivate stronger thinking and innovative abilities, and contribute to the improvement of high school students' biology levels and their comprehensive and all-round development.

3.3. Inadequate construction of the teaching evaluation system

The inadequate construction of the teaching evaluation system is a key bottleneck restricting the improvement of high school biology teaching quality. Currently, the evaluation of students' biology learning mainly focuses on summative evaluation, such as mid-term and final exam scores, while less attention is paid to and applied in process-based evaluation. This "score-only" evaluation system is likely to cause students to memorize mechanically and pursue short-term results, ignoring the overall assessment of students' biological core qualities. In addition, the evaluation methods are relatively single, lacking a comprehensive evaluation of students' cooperation and communication skills, innovation abilities, and problem-solving strategies, and unable to comprehensively and accurately reflect students' learning progress and development potential. In other words, the incomplete construction of the evaluation system makes it difficult for students to receive positive feedback. If students get stuck in their own thinking, it will be even more difficult for them to improve their biology grades and levels, let alone achieve long-term development and progress.

4. High school biology teaching strategies based on the STEM education concept

4.1. Guided by diversified curriculum objectives to lead all-around development

From the perspective of STEM education, the goals of high school biology education are not limited to the imparting of biological knowledge and skills but should focus on guiding students' all-around development. To achieve this goal, high school biology teachers should consciously integrate the knowledge of multiple disciplines and fully demonstrate the comprehensive, open, practical, and exploratory characteristics of biology teaching. By setting multi-level and multi-field curriculum objectives, students can acquire a wider range of skills while learning, laying a foundation for cultivating their core qualities^[9].

Thinking objectives: Different from the teaching objectives of traditional single-subject teaching, the biological education objectives based on STEM education should focus on cultivating students' thinking methods of flexibly applying biological knowledge and skills to solve complex, real-world problems, helping them master relevant methods. In addition, through a large number of biological practices and experiments, attention should also be paid to cultivating students' good emotional thinking and complex cognitive thinking^[10].

Knowledge objectives: Knowledge objectives are of utmost importance in STEM education. Only when students master the basic facts and procedural knowledge of multiple disciplines, including biology, can they deeply understand and solve complex problems.

Ability objectives: The primary goal of biological education based on STEM education is to cultivate students' interdisciplinary comprehensive abilities and the ability to solve real-world problems. At the same time, it also focuses on cultivating their good teamwork spirit, laying a foundation for students' in-depth learning of biology.

Innovation objectives: Innovation objectives belong to high-level goals. The aim is to cultivate students' good innovative qualities by actively creating a strong innovation-culture atmosphere and formulating personalized training objectives, implementing high-quality education, thereby promoting the coordinated development of knowledge innovation and practical abilities, and leading the biology classroom towards an innovative path ^[11].

4.2. Developing a biological perspective by taking real-life situations as the carrier

STEM education emphasizes restoring biological knowledge to rich real-life situations, enabling students to have a more profound and comprehensive understanding of the origin and development of biological knowledge. Based on this, to broaden students' biological perspectives, guided by the STEM education concept, biology teachers should use real-world situations as carriers and carefully design situation-based tasks closely related to real life. For example, through diverse activities such as data analysis and model building, teachers can guide students to carefully observe the biological elements contained in real-life examples and naturally apply biological knowledge and skills, thus deepening their understanding of abstract biological knowledge ^[12]. This is conducive to developing students' biological abstract literacy on the one hand and enhancing their ability to observe the world from a biological perspective on the other hand, significantly improving the teaching quality. The basis and key to real-life situation teaching lie in the selection of real-life situations. An appropriate real-life situation can fit the teaching content, enabling students to have a more intuitive understanding and in-depth mastery of the knowledge they learn. At the same time, it is also an effective measure to mobilize students' learning enthusiasm and stimulate their learning interests. For example, when teaching the content of "sex-linked inheritance", the teacher can first pose a real-life-related question: "Classmates, do any of you have friends with red-green color blindness? Are they male or female?" Immediately, the classroom becomes lively, and students start discussing the question. After that, the teacher assigns an investigation task: "Investigate whether there are any red-green color-blind teachers and students in the school and classify the data." After forming research groups, students are full of enthusiasm. They divide tasks step by step, record carefully, and conduct extensive interviews to accurately screen out people with color-blindness genetic diseases. Finally, the teacher guides students to calculate the color-blindness incidence rates of male and female students respectively, based on the survey data and conduct a comparative analysis, closely integrating learning with life. By creating real-life learning situations, students can be influenced by knowledge imperceptibly, and their comprehensive abilities can be cultivated and exercised, which is conducive to laying a solid foundation for enhancing their core qualities. In addition, teachers can also complete the task of situation creation by combining social hot topics. Fundamentally, biological knowledge comes from life and is higher than life. The ultimate goal of students learning biological knowledge is to specifically solve a series of real-world problems. Therefore, teachers can precisely extract some biological knowledge points closely related to life around social hot topics, bringing students a new learning experience.

4.3. Relying on inquiry-based learning to strengthen thinking experiences

Cultivating students' scientific spirit and rational thinking is an important part of core qualities. Guided by the STEM education concept, in addition to emphasizing the deductive reasoning of knowledge and constructing a systematic biological knowledge system when cultivating students' biological core qualities, it is also necessary to cultivate students' ability to think about the world from a biological perspective ^[13]. Based on this, biology

teachers should rely on inquiry-based learning, carefully design open-ended questions and complex tasks, truly present the thinking process of students, and encourage them to conduct experiments bravely. Through a series of steps such as making hypotheses, conducting experiments, and verifying conclusions, students can independently discover and summarize laws, thereby strengthening their logical thinking, critical thinking, and creative thinking, and bringing them rich thinking experiences. For example, the content related to “cells” is the basis for learning and understanding biology. The teaching quality of this part is directly related to the depth and breadth of students’ learning of subsequent content such as cell engineering and the conversion and utilization of cell energy. Therefore, it is important and necessary to improve the teaching quality of this part. In the actual teaching process, first, the author uses multimedia to display videos to let students visually experience the process of life from birth to growth. For example, by showing a video of a baby’s birth, the author guides students to think about the question, “Where do humans come from?” This demonstration can help students better understand their origin and growth process. At the same time, students are encouraged to think and share their views with their deskmates and classmates sitting in front of or behind them. As the discussion deepens, the author finds that students will gradually extend this question to more biology-related questions, such as “Humans develop from cells”, “So, where do cells come from?” etc. Combining the learned and unlearned relevant content, students will conduct scientific analysis and thinking and finally draw their own conclusions. From the analysis of the above-mentioned teaching segment, it can be seen that when students explore the question “Where do humans come from?”, their thinking shows obvious characteristics, such as going from shallow to deep and from the surface to the essence. By guiding and inspiring students to explore independently and using heuristic questions in teaching, their thinking can become more scientific and rigorous during the research process. From the perspective of teachers’ teaching, heuristic questions have outstanding teaching value. They can not only stimulate students’ thinking but also guide students to conduct independent exploration. Through this process, students will acquire valuable scientific qualities, which are conducive to guiding students to move forward towards scientific truth and finally enabling them to gradually explore the true meaning of science.

4.4. Expanding and integrating off-campus resources to cultivate students’ innovative spirit

Off-campus resources are an important supplement to high school biology teaching. Expanding and integrating off-campus resources can provide students with a broader learning space and practical opportunities. Schools can establish cooperative relationships with scientific research institutions, universities, enterprises, etc., and carry out extracurricular practical activities, allowing students to visit scientific research laboratories, production workshops, and other places to understand the practical applications of biological science ^[14]. For example, the school can cooperate with the local agricultural academy of sciences to organize students to visit the agricultural scientific research base, understand the planting techniques of crops, the methods of pest and disease control, and the application of biotechnology in agricultural production. It can also cooperate with universities to carry out biological popular science lectures, laboratory open-day activities, etc., and invite experts and scholars from universities to explain the cutting-edge knowledge and research results of biological science to students, stimulating their learning motivation and aspiration for further education. Schools can also organize students to participate in biological popular science exhibitions, biological competitions, etc., to broaden students’ horizons and improve their comprehensive qualities. Biological popular science exhibitions usually display the latest research results of biological science, biodiversity protection, the application of biotechnology,

etc. By visiting these exhibitions, students can understand the development status and social applications of biological science, enhancing their understanding and interest in biological science. Biological competitions, such as the National High School Biology Competition and the International Genetically Engineered Machine Competition, are important platforms for cultivating students' innovative and practical abilities. During the process of participating in competitions, students need to apply the biological knowledge they have learned, combine the knowledge of multiple disciplines such as science, technology, engineering, and biology, solve real-world problems, design and implement experimental projects, and display their research results. Through competitions, students can not only improve their professional knowledge level but also cultivate teamwork spirit, innovative thinking, and practical abilities, laying a solid foundation for their future study and work ^[15].

5. Conclusion

In conclusion, with the further deepening of China's education reform, high school biology teaching is gradually developing from single-subject teaching to multi-disciplinary integrated teaching. Guided by the STEM education concept and aiming to cultivate students' core qualities, teachers should flexibly adopt diversified teaching strategies. For example, be guided by diversified curriculum objectives to lead all-around development; use real-world situations as carriers to develop biological perspectives; rely on inquiry-based learning to strengthen thinking experiences; expand and integrate off-campus resources to cultivate an innovative spirit, etc. Teachers should strive to build a biology classroom that integrates learning, doing, and understanding to promote the comprehensive development of students' knowledge and skills, learning attitudes, and values.

Disclosure statement

The authors declare no conflict of interest.

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Innovative Countermeasures for Higher Vocational English Teaching Models in the Context of Artificial Intelligence

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Abstract: Higher vocational colleges are crucial for cultivating high-quality technical and skilled talents in China. With the continuous advancement of the construction and reform of the modern vocational education system in the new era, the innovative development of English teaching models has become a major exploration issue. For higher vocational students, learning English well is of great significance and value. In this regard, higher vocational colleges can give full play to the enabling advantages of artificial intelligence to create personalized and interactive English learning classrooms for students, thus promoting their all-round development. Based on the current situation of higher vocational English teaching in the context of artificial intelligence, this article focuses on how to use artificial intelligence technology to innovate the English teaching model, aiming to improve students' language application ability.

Keywords: Artificial intelligence; Higher vocational English; Teaching innovation

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1. Introduction

In the context of artificial intelligence, it is essential to build a new development path for higher vocational English teaching relying on intelligent technology to deepen the construction and reform of the modern vocational education system. However, problems such as teaching content being divorced from vocational needs and the simplification of teaching resources have led to many development dilemmas in higher vocational English teaching. Therefore, exploring new ideas and methods for innovating higher vocational English teaching models using artificial intelligence technology can help construct an English teaching model that meets the goals of the modern vocational education system construction, fully demonstrating the application value of artificial intelligence in the education field and facilitating students' personalized learning.

2. Analysis of the current situation of higher vocational English teaching in the context of artificial intelligence

2.1. Disconnection between course content and vocational needs

Higher vocational English teaching should highlight the particularity of vocational education, that is, be oriented towards workplace applications and strengthen the connection between course content and vocational needs. However, the disconnection between course content and vocational needs has become an important issue restricting the innovative development of higher vocational English teaching. This reflects that higher vocational English has not established a corresponding teaching system according to the actual situation of market occupations ^[1]. Under the long-term constraints of traditional educational ideas, higher vocational English teaching over-emphasizes the cultivation of students' basic language skills, such as listening, speaking, reading, and writing abilities. Although this teaching model can lay a solid foundation for students' learning, due to its lack of vocational characteristics, it is difficult to guide them to master specific vocational skills in professional fields, such as industry communication skills and business English negotiation. In addition, English teaching that mainly focuses on written and theoretical aspects makes it difficult for teachers to create vocational practice scenarios in the classroom, resulting in students being in an embarrassing situation of "being able to write but not speak" and unable to apply theoretical English knowledge to practical communication. The disconnection between English teaching content and vocational needs not only makes it difficult to improve the practicality of English education but also is not conducive to students' future career development, affecting the improvement of the quality of applied-talent cultivation ^[2]. This problem weakens the vocational training function of higher vocational English teaching and increases the difficulty for students to acquire vocational skills and knowledge.

2.2. Relatively backward teaching methods

Since the advent of the artificial intelligence era, higher vocational English teachers should keep pace with the times to improve their digital literacy and digital teaching capabilities and actively use artificial intelligence technology to innovate and optimize teaching work ^[3]. However, due to the deep-rooted influence of traditional teaching ideas, the application of technical means in English teaching still remains at a superficial level, merely using them as auxiliary tools to present course content. Moreover, some teachers are accustomed to using the previous single-form teaching method, that is, the inculcation-based teaching method under the large-class teaching system. This single-form teaching method ignores the personalized and differential needs of students from different majors, easily causing them to develop negative emotions such as boredom and resistance in the course of learning, thus affecting the improvement of the overall teaching effect. In addition, the large-class teaching system increases the difficulty for English teachers to implement classroom teaching, making it difficult for them to organize and carry out targeted teaching activities according to the professional backgrounds of students ^[4].

2.3. Relatively traditional evaluation system

The evaluation of higher vocational English courses often relies on written examinations to assess and test students' mastery and application of basic knowledge. This evaluation model is one-sided and difficult to evaluate students' language expression abilities and cross-cultural communication abilities in language application scenarios. It can be seen that the existing English evaluation system in higher vocational colleges severs the relationship between education and teaching and students' career development, ignores the practicality of English education, and is not conducive to cultivating students' vocational skills ^[5]. Specifically,

the single-form evaluation method mainly based on written examinations is difficult to accurately identify the differences among students' listening, speaking, reading, and writing abilities and cannot provide them with practical learning suggestions. The vocational education reform in the new era aims to cultivate master craftsmen and skilled artisans. However, the current English evaluation method in higher vocational colleges fails to stimulate students' initiative in exploring practical skills, resulting in students being more inclined to mechanical learning. In addition, some higher vocational English teachers neglect to use artificial intelligence technology to optimize the evaluation method and lack the initiative to use artificial intelligence technology for teaching innovation, which is not conducive to giving full play to the guiding function of evaluation and is also not conducive to improving students' comprehensive qualities ^[6].

3. Innovative countermeasures for higher vocational English teaching models in the context of artificial intelligence

3.1. Emphasize technology applications to promote personalized development

Artificial intelligence technology provides new technical means and resource support for the modernization reform of higher vocational English teaching and is a practical guarantee for teachers to implement personalized teaching. Higher vocational English teaching focuses on the explanation of language knowledge and the cultivation of skills in professional fields, and its teaching objectives should be consistent with the overall requirements of vocational colleges for the cultivation of technical and skilled talents. However, some teachers still have not broken free from the shackles of the traditional teaching model and continue to use the "preaching-style" teaching method, resulting in students being in a passive and submissive learning position for a long time, and their subjective initiative is difficult to fully exert. With the wide application of artificial intelligence technology in education and teaching, the traditional teaching model can no longer adapt to the development of the digital and intelligent education environment. Higher vocational English teachers urgently need to take advantage of the educational benefits of artificial intelligence technology to strengthen classroom innovation and enrich the application of technical means in English classrooms ^[7].

For example, with the empowerment of artificial intelligence technology, adaptive teaching can be implemented. Specifically, higher vocational English teachers can upload students' test scores, learning habits, learning time, and other data to the artificial intelligence platform and use the algorithm function of the platform to comprehensively analyze students' language levels and learning progress. On this basis, personalized data analysis results can be generated to adjust the teaching content and difficulty. In this way, with the assistance of artificial intelligence, English teachers can provide students with personalized suggestions to help them maximize their personal value in learning. This is an effective way for higher vocational English teachers to implement the concept of teaching students in accordance with their aptitudes and achieve personalized teaching ^[8]. Another example is that the artificial intelligence platform can push personalized learning resources to students according to their different learning habits, characteristics, and professional backgrounds, and provide personalized learning plans and paths. The traditional higher vocational English teaching mainly based on large-class teaching neglects the professional backgrounds of students, and the lack of targeted listening and speaking exercises makes it difficult to meet the differential and personalized needs of different students. In this regard, higher vocational English teachers can use the artificial intelligence system to recommend matching learning resources to students. In short, when applying technical means to implement personalized teaching, higher

vocational English teachers need to break free from the shackles of the traditional teaching framework, establish new digital and information-based teaching thinking, and then rely on artificial intelligence technology to construct a new teaching system based on students' learning situations, to provide students with a personalized English learning experience in education and teaching and fully stimulate their internal driving force for learning.

3.2. Create interactive situations to guide independent expression

The core goal of higher vocational English teaching is to cultivate high-quality applied technical and skilled talents oriented towards career development. However, higher vocational English teachers over-emphasize written expression and exam-oriented education in teaching and do not pay much attention to training students' oral expression and communicative application abilities in the classroom, resulting in the common phenomenon of "mute English" in the field of English education and making it difficult to provide practical English translation talents for various industries^[9]. It can be seen that "mute English" has become a key factor restricting the career development of higher vocational students. Therefore, creating real-life interactive situations in higher vocational English teaching based on artificial intelligence technology and strengthening students' oral training can fundamentally solve the learning problem of "being able to write but not speak", further promote the development and improvement of their disciplinary core qualities, and lay a good foundation for their career development.

Creating interactive learning situations according to industry scenarios is a concrete manifestation of innovating higher vocational English teaching using artificial intelligence technology. It can create an immersive language learning environment for students and lead them to simulate language dialogues in future career scenarios. Specifically, higher vocational English teachers can use means such as virtual reality technology and augmented reality technology, starting from the professional backgrounds of students, to build communicative dialogue scenarios, such as business negotiations and customer service exchanges^[10]. Bringing the real-life situations that students may encounter in their future career development into the classroom can not only train their oral expression abilities but also help them master professional English expressions and practice their negotiation skills. This significantly enhances the practicality of higher vocational English teaching and can effectively improve students' initiative and enthusiasm for participating in interactive learning. In addition, in situational communication, English teachers can also guide students to have one-on-one conversations with artificial intelligence-driven characters. Artificial intelligence can build different character scenarios based on industry information and provide students with diversified voice interaction opportunities. Human-machine interaction is of great help in enhancing students' desire to express themselves, allowing them to continuously improve their oral communication skills in real-life scenario simulations. Relying on artificial intelligence to create industry-simulation scenarios and promote the interactive learning of higher vocational students can effectively improve the innovation of English teaching, enabling them to practice their English communication skills in simulated career scenarios and environments, and thus improve their career competitiveness on this basis^[11].

3.3. Optimize the evaluation system to strengthen the educational effect

Optimizing the evaluation system of higher vocational English teaching can help students build self-confidence during the learning process and cultivate good language learning interests^[12]. The traditional way of evaluating

higher vocational English courses is relatively single. Teachers often evaluate students based on their test scores, without conducting formative evaluations combined with their learning processes and dynamics. As a result, the “score-oriented” ideology has long dominated the field of course evaluation, ignoring students’ subjective initiative and making it difficult to fully stimulate their English learning interests^[13]. Moreover, the subject of this evaluation method is also relatively single. Students usually only receive scores from teachers, which affects their self-reflection and self-improvement. The core goal of higher vocational English teaching is to promote the all-round development of students and implement the fundamental task of “cultivating morality and nurturing people.” Therefore, using artificial intelligence technology to construct a dynamic and continuous English teaching evaluation system can effectively address the shortcomings of the traditional evaluation model and integrate the advantages of formative evaluation and summative evaluation^[14]. Specifically, higher vocational colleges can develop an automatic artificial intelligence-based teaching evaluation system. Using its intelligent algorithms and data models, it can objectively and quantitatively evaluate students’ English learning and generate personalized learning-situation diagnosis reports covering learning attitudes, learning achievements, learning methods, etc. This is not only helpful for improving the evaluation efficiency of English courses but also can reduce the interference of human factors and give students objective, fair, and accurate evaluations. At the same time, the automatic evaluation system can process a large amount of data in a short time, which greatly saves the time cost of English teachers. It should be noted that the automatic evaluation system developed relying on artificial intelligence technology is essentially an auxiliary tool and cannot replace the initiative of teachers in course evaluation. Therefore, higher vocational English teachers should be vigilant against the influence of the “technology-supremacy” trend of thought to ensure the harmonious co-existence of technology application and educational development, and thus continuously strengthen the educational effect of English teaching on this basis^[15].

4. Conclusion

Innovating the higher vocational English teaching model using artificial intelligence technology is an important part of building a modern vocational education system. Therefore, higher vocational colleges should deeply explore the application potential of artificial intelligence technology in the education field, combine its advantages and characteristics, and construct an English teaching model that meets the standards of teaching reform. Through measures such as implementing personalized teaching, creating interactive situations, and optimizing the evaluation system, the organic combination of theory and practice can be promoted, and students’ disciplinary core qualities can be further developed.

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Research on the Cultivation Path of International Talents in Higher Vocational Colleges under the Belt and Road Initiative

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Abstract: With the in-depth advancement of the Belt and Road Initiative, the demand for international talent is becoming increasingly urgent. As an important base for cultivating technical and skilled talents, higher vocational colleges play an irreplaceable role in serving the national strategy and facilitating the Belt and Road Initiative. Starting from the background of the Belt and Road Initiative, this article analyzes its value in cultivating international talents and points out the important role of international talents in promoting economic cooperation and cultural exchanges among countries along the Belt and Road. On this basis, combined with the current situation of cultivating international talents in higher vocational colleges, the study deeply analyzes the main existing dilemmas. This not only provides theoretical references and practical guidance for cultivating international talents in higher vocational colleges but also offers useful explorations for innovating the training model of technical and skilled talents under the background of the Belt and Road Initiative.

Keywords: The Belt and Road Initiative; Talent cultivation; Higher vocational colleges; International talents

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1. Overview of the background of the Belt and Road Initiative

1.1. Definition of the Belt and Road Initiative

The Belt and Road Initiative is a major international cooperation initiative proposed by China, which stands for “the Silk Road Economic Belt” and “the 21st-Century Maritime Silk Road.” Since its proposal over a decade ago, the Belt and Road Initiative has entered a stage of improving quality and efficiency from scale development. The initiative aims to promote regional cooperation and common prosperity by strengthening policy coordination, infrastructure connectivity, unimpeded trade, financial integration, and people-to-people and cultural exchanges among countries along the routes ^[1]. In terms of connotation, the Belt and Road Initiative is not only a platform for economic cooperation but also an important link for cultural mutual learning

and people-to-people connectivity. Its core lies in building a new model of international cooperation for mutual benefit and win-win results through open cooperation.

1.2. The value of the Belt and Road Initiative in cultivating international talents

Firstly, the Belt and Road Initiative promotes economic cooperation and exchanges among countries along the routes. Through cultivating international talents, higher vocational colleges can provide high-quality technical and skilled talents for these countries, contributing to local economic development and industrial upgrading. Secondly, the Belt and Road Initiative emphasizes cultural diversity and mutual learning among civilizations. By cultivating international talents, higher vocational colleges can help students better understand the cultural backgrounds and business environments of different countries, and cultivate their cross-cultural adaptability and international competitiveness ^[2]. In addition, the Belt and Road Initiative promotes the international development of vocational education, providing higher vocational colleges with opportunities for educational cooperation that align with international standards. This international cooperation model not only improves the educational quality of higher vocational colleges but also provides rich resources and practical experience for cultivating international talents.

1.3. The promotional role of the Belt and Road Initiative in innovating the educational model of higher vocational colleges

With the in-depth implementation of the Belt and Road Initiative, the demand for technical and skilled talents from countries along the routes is increasing. Higher vocational colleges can develop more professional courses and training programs that meet international standards according to actual needs. In addition, higher vocational colleges can take the opportunity of the Belt and Road Initiative to carry out school-enterprise cooperation with countries along the routes, promoting the integrated development of “production, education, and research”. Through cooperation with international enterprises, students can intern in a real-world international scientific research environment, accumulate practical experience, and enhance their employability. At the same time, colleges can also absorb more international educational resources, such as hiring foreign teachers, updating teaching facilities, and sharing the latest educational technologies, thus improving the overall educational level ^[3-5].

2. Dilemmas in cultivating international talents in higher vocational colleges

2.1. Vague positioning in cultivating international talents

Higher vocational colleges lack a clear positioning in the training objectives, directions, and paths of international talents, resulting in many problems during the talent-cultivation process ^[6]. Firstly, the training objectives are unclear. Higher vocational colleges fail to accurately define the connotation of “internationalization” in cultivating international talents, leading to unsatisfactory training results. Secondly, the training direction is ambiguous. Higher vocational colleges fail to clearly position the target group in cultivating international talents, making it difficult to optimize the training model, and resulting in a lack of pertinence and effectiveness in cultivating international talents.

2.2. Low international literacy of the teaching staff

Firstly, teachers generally have insufficient foreign language skills. In the countries along the Belt and Road, there are a wide variety of languages, which pose higher requirements for teachers. However, among the current

teaching staff in higher vocational colleges, the number of teachers who can proficiently master the languages of these countries is extremely limited. Secondly, teachers' cross-cultural communication skills are relatively weak. International education requires teachers not only to have language skills but also cross-cultural understanding and communication skills ^[7-9]. However, most teachers in higher vocational colleges lack an international perspective and cross-cultural experience and have insufficient understanding of the cultures, educational systems, and social customs of countries along the Belt and Road. The lack of cross-cultural capabilities makes teachers often feel overwhelmed when communicating with international partners, guiding international students, or carrying out transnational projects, thus affecting the effectiveness of international education.

2.3. Incomplete school-government-enterprise collaborative cooperation

Firstly, the school-government-enterprise collaborative cooperation mechanism is imperfect. Higher vocational colleges lack an effective communication and collaboration mechanism with the government and enterprises during the process of cultivating international talents. Secondly, the collaborative goals of schools, governments, and enterprises are inconsistent. In cultivating international talents, the goals and demands of schools, governments, and enterprises vary. Schools pay more attention to the quality and characteristics of talent cultivation, the government focuses more on policy guidance and resource allocation, and enterprises are more concerned about the practicality and matching degree of talents. This inconsistency in goals makes it difficult for schools, governments, and enterprises to form a joint force, and it is difficult to build a systematic and sustainable international talent-cultivation model. Thirdly, the school-government-enterprise collaborative cooperation lacks an international perspective ^[10-11]. Under the background of the Belt and Road Initiative, cultivating international talents requires a global perspective and an open-minded approach. However, current cooperation among schools, governments, and enterprises is more limited to the domestic level, lacking an international perspective and the ability to integrate international resources.

3. Cultivation paths of international talents in higher vocational colleges under the Belt and Road Initiative

3.1. Top-level design: Clarifying the targets and objectives of cultivating international talents in higher vocational colleges

Students enrolled through Sino-foreign cooperative education programs are the main group of international talents in higher vocational colleges. By cooperating with higher vocational colleges or vocational education institutions around the world, joint courses and degree programs that meet international requirements can be established, providing students with opportunities for dual degrees and cross-cultural exchanges, enhancing their international perspective and transnational vocational skills, and cultivating compound technical talents with Chinese characteristics who can also meet the needs of the global market ^[12]. International students coming to China, especially those from the Belt and Road countries, are also an important source of international talent in higher vocational colleges. By improving their technical abilities and practical experience, they can become bridges for cultural exchanges between China and other countries and promote the internationalization of China's vocational education brand. In addition, with the advancement of overseas cooperative education projects of vocational colleges, local personnel in recipient countries of foreign-aid education are another key group of international talents in higher vocational colleges. Through vocational education brands such as Luban Workshops and Silk Road Institutes, higher vocational colleges can dispatch teachers and training experts to

provide vocational skills training and curriculum support to recipient countries. This not only helps to improve the vocational education level of recipient countries but also cultivates a group of technical talents that meet the development needs of their own countries, promoting international cooperation and talent exchanges in Chinese-characteristic vocational education.

3.2. Teaching staff construction: Building a “dual-qualified” teaching team with “international literacy + vocational skills”

To meet the needs of cultivating international talents, higher vocational colleges must build a “dual-qualified” teaching team with both an international perspective and solid vocational skills. Firstly, teachers should have strong cross-cultural communication skills and international education concepts, and be able to help students expand their international perspective and improve their cross-cultural adaptability^[13]. In addition, teachers need to continuously improve their professional skills, especially in response to the specific industrial requirements of countries along the Belt and Road, and cultivate a teaching team that can directly serve international development.

Therefore, higher vocational colleges can take the following measures. Firstly, strengthen international exchanges and cooperation for teachers. Encourage teachers to conduct academic exchanges, training, and short-term secondment in countries along the Belt and Road. By actually participating in international projects, teachers can improve their cross-cultural adaptability and international teaching experience. Secondly, introduce foreign teachers and experts to enrich the diversity of the teaching team, form a diversified teaching resource, and improve the international level of teaching. Thirdly, promote the “enterprise-college” cooperation model. Invite industry experts and enterprise technicians to participate in the teaching process, which not only improves teachers’ vocational skills but also enables them to provide students with more practical operations and an international perspective.

3.3. International communication: Strengthening the construction of international digital teaching resources

By building international digital teaching resources, schools can promote the “going global” of vocational education and the international communication of Chinese-characteristic vocational education. With the acceleration of the global digital process, the construction of international digital teaching resources has become an important means to promote the “going global” of vocational education. Higher vocational colleges should make full use of information technology to build an open and shared digital teaching resource platform, to spread Chinese-characteristic vocational education to the Belt and Road countries, and to promote Chinese vocational education to the world. Higher vocational colleges can use digital technology and online platforms to develop vocational education courses with multi-language and multi-cultural backgrounds that meet international requirements. Through transnational platforms and virtual classrooms, the limitations of time and space can be broken, allowing students in the Belt and Road countries to receive Chinese higher vocational education anytime and anywhere, and improving their professional skills and cultural understanding^[14]. International digital resources can also be optimized and shared through cooperation with well-known international educational institutions to improve the international level and teaching quality of courses. For example, in fields such as transportation and engineering technology, digital textbooks and cases can be jointly developed with vocational colleges or industry associations in countries along the Belt and Road to form a

globally competitive textbook system. The construction of digital resources can also promote the interaction and communication between Chinese and foreign teachers and students, establish transnational education communities, share educational concepts and practical experiences, and further strengthen cultural identity and technical cooperation. This not only helps to enhance the international influence of Chinese vocational education but also provides new opportunities for the “going global” of Chinese vocational education, promoting the in-depth spread of Chinese-characteristic vocational education on a global scale. Through the construction of international digital teaching resources, the internationalization process of cultivating “Made-in-China” talents can be effectively promoted, and transnational cooperation and win-win development in vocational education can be achieved.

3.4. Integration of industry and education: Relying on the international brand of vocational colleges

In the new era of vocational education development, the integration of industry and education is not only the core feature of vocational education but also a key path to promoting the cultivation of international talents. To achieve this goal, higher vocational colleges need to actively seek strong support from the government. As the leader in the integration of industry and education, the government should provide a solid institutional guarantee for cultivating international talents in higher vocational colleges by formulating relevant policies. For example, local governments can set up special funds to support higher vocational colleges to carry out in-depth cooperation with enterprises in countries along the Belt and Road and jointly build an international school-enterprise cooperation platform. Secondly, learning from successful models is another key way to promote the integration of industry and education ^[15]. The successful experiences of Luban Workshops and Overseas Silk Road Institutes not only demonstrate the high level of China’s vocational education but also prove the important role of the integration of industry and education in cultivating high-quality technical and skilled talents. Therefore, higher vocational colleges in various regions should actively connect with regional advantageous industries according to their own characteristics and regional advantages and establish long-term and stable cooperative relationships with multinational enterprises. This cooperation can not only match the learning content of higher vocational students with the requirements of enterprise job capabilities but also enable students to master the core skills required for actual work through jointly building international training bases and carrying out order-based talent cultivation. At the same time, higher vocational colleges should actively implement the “bringing in” strategy and recruit international students from countries along the Belt and Road. By implementing the international talent-cultivation model of “Chinese + culture + vocational skills”, international students can not only deeply understand and master the Chinese language and culture but also receive vocational skills training and certification services. The students cultivated in this way will have the ability to spread Chinese stories, culture, experience, and technology and become goodwill ambassadors.

4. Conclusion

In conclusion, the Belt and Road Initiative provides important opportunities and also sets higher requirements for cultivating international talents in higher vocational colleges. Higher vocational colleges need to adopt an open-minded perspective and innovative thinking to actively meet the challenges of cultivating international talents, cultivate more high-quality technical and skilled talents with an international perspective, cross-cultural

communication skills, and professional skills for the Belt and Road Initiative, and contribute to promoting the building of a community with a shared future for mankind.

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Application and Exploration of Matrix Production Line in Vocational Education Practice Teaching

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Abstract: This paper focuses on the application of matrix production line in the practical teaching of vocational education and analyzes its characteristics, advantages, and a series of challenges and problems in the implementation process. Given the various problems encountered in the implementation process, this paper will put forward a series of practical solutions, aiming at providing a useful reference for educators and promoting the steady improvement of the quality of vocational education practical training.

Keywords: Matrix production line; Vocational education; Practical teaching

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1. Introduction

As an important part of the education system, the core goal of vocational education is to cultivate professionals with practical operation ability and good professional quality ^[1]. In this process, practical teaching plays a crucial role, which provides a platform for students to transform theoretical knowledge into practical skills. As an efficient and flexible form of production organization, it is of great significance to introduce matrix production lines into the practical teaching of vocational education. This innovative training model can not only simulate the real work scene but also better adapt to the modern manufacturing industry's demand for diversified and interdisciplinary talents, thus laying a solid foundation for student's future career development.

2. The characteristics of the matrix production line

The matrix production line is an efficient and flexible production organization mode, which arranges and combines production equipment with different functions according to specific logical relations, thus building an organic overall production system of collaborative operation ^[2]. The characteristics of this production line layout

are remarkable. In the compact production process, each process is closely connected, reducing the flow time and loss of materials and products in the production process. The equipment layout of the matrix production line is flexible and changeable, and the equipment configuration can be quickly adjusted according to the production demand to cope with different batches or types of production tasks. This flexibility not only improves the adaptability of the production line but also significantly optimizes the efficiency of resource utilization and achieves a high degree of resource sharing. This mode is convenient for production management and quality control. Due to the clear logical relationship between the production equipment, managers can easily monitor the production progress, timely detection, and resolution of potential problems, to ensure stable and reliable product quality.

3. The application advantages in vocational education practical training teaching

3.1. Improving students' comprehensive vocational ability

Students in the matrix production line for practical training can access the complete production process from raw material processing to finished product output, and master the operation skills of a variety of equipment, such as mechanical processing students can learn CNC lathes, milling machines, machining centers and other equipment collaborative use, to improve the comprehensive practical ability and professional quality, after graduation can quickly adapt to the complex production environment of enterprises.

In the process of teamwork in the completion of production tasks, students learn to communicate, coordinate, and cooperate in the division of labor, and enhance team consciousness and problem-solving ability. For example, in the assembly line of electronic products, each group is responsible for the assembly and testing of different parts, and jointly completing the final assembly and debugging of products, which cultivates students' collaborative spirit and global concept ^[3].

3.2. Optimize the allocation of practical training teaching resources

Matrix production line integrates diversified practical training equipment, avoids the disadvantages of scattered equipment resources and repeated construction in traditional practical training teaching, significantly improves the utilization efficiency and sharing level of equipment, and makes full use of limited teaching resources ^[4]. For example, in the field of mold manufacturing training, the model will be mold design, precision machining, strict testing, and other key equipment centralized layout, build an efficient collaborative matrix production line, not only fully meet the diversified needs of teaching and training, but also greatly save valuable space, reduce unnecessary equipment procurement costs.

In addition, the matrix production line also helps the school to carry out centralized management and professional maintenance of practical training equipment. The school can assign professional and technical personnel to implement unified maintenance operations for the entire production line, to effectively reduce the failure rate of equipment and ensure the smooth and orderly development of practical training and teaching activities. At the same time, this mode is also convenient for schools to update and upgrade equipment in a timely manner, and constantly improve the modernization level and technological advancement of practical training teaching ^[5].

3.3. Improve the authenticity and effectiveness of practical training teaching

As an innovative teaching mode, a matrix production line successfully simulates the real production scene and

process flow of enterprises, providing students with a practical training platform that is close to actual combat ^[6]. On this platform, students can not only feel the intense and orderly production atmosphere and unique corporate culture of the enterprise but also deeply understand and experience the specific responsibilities and skill requirements of different career positions, thus greatly enhancing the cognition and understanding of future career roles ^[7]. This immersive training experience has stimulated students' strong interest in learning and high enthusiasm, laying a solid psychological and technical foundation for their future career development. Taking automobile manufacturing training as an example, matrix production lines are laid out in strict accordance with the core process processes of automobile production, such as stamping, welding, painting, and final assembly, so that students can personally experience the rigorous workflow and high standard quality control requirements of automobile production enterprises in actual hands-on operation ^[8]. This not only deepens the students' comprehensive understanding of the automotive manufacturing industry but also exercises their professional skills and teamwork ability in different production links.

In addition, teachers can also rely on the production tasks and process flow of matrix production lines to design a series of practical training projects and teaching cases that are closer to reality and more complex and changeable ^[9]. By guiding students to comprehensively apply their theoretical knowledge and practical skills to solve problems encountered in actual production, they can effectively improve their problem-solving ability and comprehensive quality, and ensure the effectiveness and high quality of practical training teaching.

4. Problems faced in the implementation process

4.1. The construction of teaching staff lags behind

The teaching mode of matrix production line puts forward more stringent professional requirements and practical challenges for teachers, who not only need to master the operation skills and maintenance knowledge of various production equipment but also must fully grasp the essence of organization management and quality control of the entire production process. Unfortunately, at present, there are still many teachers in vocational colleges who lack in-depth enterprise practice experience, and it is difficult to effectively assume the heavy responsibility of matrix production line practical training teaching, which restricts the improvement of teaching quality to a certain extent.

Teachers are also faced with challenges in terms of teaching methods and teaching organization. They need to change from the traditional teaching mode of single equipment to the comprehensive teaching mode based on matrix production line. Teachers need to conduct in-depth exploration and practice on how to reasonably arrange students' practical training posts, design teaching tasks and evaluation standards.

4.2. The difficulty of practical training teaching management increases

Matrix production line involves many production links and a variety of equipment, which makes the security management challenges faced by students in practical training more severe. For example, in the machining production line, high-speed rotating sharp tools and dense electrical equipment are hidden safety risks. Therefore, schools must build a complete set of safety management systems and emergency plans, strengthen safety education and practical training for students, so that they can always tighten the safety string, learn to standardize operation and self-protection in practical training, and ensure the safety of the entire practical training teaching ^[10].

The production task of a matrix production line has the characteristics of continuity and complexity, which makes it more difficult for schools to arrange teaching progress and evaluate students' practical training results. How to ensure the smooth progress of production tasks, while allowing each student to obtain sufficient practical training and effective guidance, as well as how to measure the performance and ability growth of students in the whole course of practical training fairly and accurately, these are the key issues to be solved urgently by the school, which requires the school to develop a scientific and reasonable teaching management system and evaluation system.

4.3. High equipment investment and maintenance costs

The construction of matrix production lines is undoubtedly a major investment, which not only requires the initial purchase of a large number of advanced equipment but also requires sophisticated layout design and installation and commissioning work, so the required capital is quite large. More importantly, with the rapid development of science and technology, the upgrading speed of equipment technology is extremely fast, to ensure that the production line always remains competitive, continuous upgrading funds are also essential, which for vocational colleges with limited financial strength, undoubtedly constitutes no small economic pressure.

The maintenance of matrix production line equipment is also a complex and arduous task, which cannot be separated from professional technical personnel and advanced maintenance tools, coupled with the high cost of replacement and maintenance of equipment parts, once the equipment fails and cannot be quickly repaired, it will not only affect the normal progress of practical training and teaching, but also reduce the utilization rate of equipment and the overall investment benefit. This will bring additional losses to vocational colleges ^[11].

5. Solutions

5.1. Improving the teaching staff

Vocational colleges should strengthen cooperation with enterprises, regularly select teachers for enterprises for temporary training and practical training, so that teachers can deeply understand the production process and technology application of enterprises, master the practical operation and management experience of matrix production lines, and improve teachers' practical teaching ability.

Actively introduce technical and management talents with enterprise work experience as part-time teachers to enrich the teaching staff and optimize the teaching structure ^[12]. Part-time teachers can introduce the actual production cases and projects of enterprises into practical teaching and teach students the latest industry knowledge and technical skills. At the same time, they can also help teachers in the school to improve the overall quality of teachers.

Organize teachers to participate in relevant teaching training and academic exchange activities, encourage teachers to carry out teaching research and reform, explore teaching methods and teaching models suitable for matrix production line practical teaching, and improve teachers' teaching level and innovation ability.

5.2. Improve the management system of practical training

Establish and improve the safety management system of practical training teaching in matrix production lines, clarify safety responsibilities, strengthen safety education and training for students, standardize students' operational behaviors, and ensure the safe and orderly conduct of practical training teaching. For example, safety warning signs should be set up in the training workshop, necessary safety protection equipment should be

equipped, and equipment operation procedures and safety inspection systems should be formulated ^[13].

Optimize the teaching schedule arrangement and the evaluation method of students' practical training results, formulate detailed teaching plans and practical training assignments according to the production tasks of the matrix production line and the actual situation of students, and reasonably allocate students' practical training positions and time to ensure that each student can be fully trained in different production links. At the same time, the establishment of a diversified evaluation system, comprehensive consideration of students' operational skills, teamwork ability, problem-solving ability, professional quality, and other aspects of performance, and objective and comprehensive evaluation of students' practical training results.

Strengthen the management and monitoring of the practical training teaching process, establish teaching quality feedback mechanism, timely understand students' learning situation and teachers' teaching effect, find problems timely adjustment and improvement, and constantly improve the quality of practical training teaching.

5.3. Expand capital investment channels and reduce equipment costs

Vocational colleges should actively strive for the financial support and policy support of the government, increase the investment in practical training teaching equipment, and improve the practical training teaching conditions. At the same time, schools can cooperate with enterprises to build training bases, enterprises to provide some equipment or financial support, schools to provide personnel training and technical services for enterprises, to achieve mutual benefit and win-win situation, and to share equipment investment and maintenance costs ^[14].

Reasonable planning of equipment purchase and update plan, according to the school's professional Settings and teaching needs, choose cost-effective, adaptable equipment, to avoid blindly pursuing high-end equipment caused by waste of resources. At the same time, strengthen the daily maintenance and management of the equipment, extend the service life of the equipment, reduce the maintenance cost, and update the frequency of the equipment.

6. Conclusion

The application of a matrix production line in the practical teaching of vocational education has broad prospects and important value, which can effectively improve students' comprehensive vocational ability and the quality of practical teaching ^[15]. Although there are some problems in the implementation process, through strengthening the construction of teachers, improving the practical training teaching management system, and expanding capital investment channels, educators can give full play to the advantages of a matrix production line, train more high-quality technical and technical talents for vocational education to meet the development needs of modern manufacturing industry, and promote the development of vocational education.

Disclosure statement

The author declares no conflict of interest.

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Talent Development of the E-Commerce Major Based on Industry-Education Cooperation

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Abstract: The rapid growth of the digital economy has made cross-border e-commerce a major driver of global trade, increasing the demand for skilled professionals in the e-commerce sector. Traditional education models can no longer meet the industry's evolving needs. This paper examines how to cultivate e-commerce talent through industry-education collaboration, focusing on areas such as curriculum design, teaching innovation, school-enterprise cooperation, and practical platform development. The study shows that this collaborative model bridges the gap between education and industry, enhancing students' practical skills, innovation, and cross-cultural communication, preparing them for digital transformation and global markets. The paper concludes with recommendations to update curricula, deepen industry partnerships, promote interdisciplinary integration, and enhance innovation and cross-cultural skills, offering theoretical and practical guidance for e-commerce talent development.

Keywords: E-commerce; Industry-education collaboration; Cross-border e-commerce; Talent cultivation

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1. Introduction

E-commerce, particularly cross-border e-commerce, has become a key driver of global economic growth. The shift in global trade models and widespread internet usage make it central to international trade^[1]. As projected by eMarketer, global e-retail sales will exceed \$7 trillion by 2025, with China leading in market size and transaction volume^[2].

However, the current e-commerce education system lags behind the industry's fast-paced evolution. There is an increasing demand for versatile talent skilled in cross-cultural communication, data analysis, innovation, and digital technologies^[3]. Traditional e-commerce programs often emphasize theory but lack practical experience, hindering students' adaptability to the rapidly changing market.

The industry-education collaborative model seeks to bridge this gap by integrating education with industry needs. Through school-enterprise cooperation, both parties can jointly design curricula, set training objectives,

and develop practical platforms, cultivating talent with theoretical expertise and real-world problem-solving skills ^[4]. This paper explores how this collaborative model can address the talent demands of the cross-border e-commerce sector in the digital economy, offering both theoretical and practical insights for the industry's high-quality growth.

2. Overview of the industry-education collaborative talent cultivation model

The industry-education collaborative talent cultivation model integrates education with industry by fostering collaboration among schools, enterprises, and governments. Its goal is to align curricula with industry needs, ensuring the development of high-quality talent that meets evolving market demands. This model enhances students' practical skills, improves teaching quality, and strengthens the talent pool for enterprises, benefiting both education and industry.

2.1. Definition and characteristics of the industry-education collaborative talent cultivation model

This model combines educational and practical resources, focusing on both theoretical knowledge and hands-on experience through internships. Its core feature is the integration of academia, industry, and research, enabling schools, enterprises, and industry associations to work together. It cultivates versatile talent that is ready to adapt to fast-changing industries ^[5]. The model includes three forms of collaboration as follows.

School-enterprise collaboration: Schools adjust curricula while enterprises provide practical platforms and contribute to course design.

Theory-practice collaboration: Enterprises offer real-world scenarios through internships and projects.

Long-term collaboration: Stable cooperation through joint training bases, faculty exchanges, and projects ensures continuous alignment between education and industry.

2.2. Necessity of industry-education collaborative talent cultivation

As industries like cross-border e-commerce grow, there is a pressing need for an education system that cultivates versatile, innovative talent. Traditional education models often fail to meet these demands, leaving students with insufficient practical experience. The industry-education model bridges this gap by providing real-world exposure and aligning curricula with industry needs. It enhances students' skills, drives technological innovation, and ensures a steady supply of skilled talent, contributing to the growth of industries like cross-border e-commerce and supporting societal development.

3. Current situation and challenges in e-commerce talent cultivation

With the rapid growth of global e-commerce, particularly cross-border e-commerce, the demand for skilled talent in the industry has become urgent. While many higher vocational colleges and technical schools in China offer e-commerce programs, they face several challenges in teaching and talent cultivation, including a disconnect between course content and industry needs, outdated teaching methods, and insufficient faculty resources.

3.1. Major problems in e-commerce education

The primary issue in e-commerce education is the lag in course content and updates. Although many institutions offer e-commerce courses, they mostly focus on traditional subjects like marketing and international trade, with limited coverage of emerging fields such as cross-border e-commerce, data analysis, and digital marketing. The traditional curriculum no longer meets the fast-evolving demands of the market, particularly with digital transformation and globalization reshaping the industry.

Another significant issue is the lack of diverse teaching methods. Many vocational schools still rely on traditional classroom teaching, emphasizing theory over practice. As a result, students often face a gap between theory and real-world application, especially in dynamic sectors like cross-border e-commerce. Traditional methods are insufficient for developing the skills needed to tackle industry challenges.

3.2. Disconnect between traditional models and industry needs

Traditional e-commerce curricula focus mainly on basic knowledge, but the rapid development of cross-border e-commerce exceeds the scope of traditional courses. Students need expertise in digital technologies, data analysis, legal knowledge, and cross-cultural communication in addition to marketing and logistics. However, current curricula lack systematic training in these emerging areas, leaving students unprepared for real-world job requirements.

Moreover, most collaborations between institutions and industry enterprises remain superficial. While some schools integrate internships and cooperative course development, the depth of cooperation is insufficient. Enterprises may participate in course design and internship arrangements, but their involvement in content updates, faculty training, and teaching innovation remains limited, perpetuating a gap between education and industry needs.

3.3. Limitations of the e-commerce talent cultivation system

In addition to curriculum and teaching method issues, the e-commerce talent cultivation system itself is limited. Traditional education focuses on knowledge transfer and skill development but neglects the cultivation of comprehensive abilities, such as innovative thinking, problem-solving, and teamwork. These skills, essential for cross-border e-commerce, are difficult to develop within traditional education frameworks.

Furthermore, the rapid technological evolution in cross-border e-commerce—driven by advances in big data, AI, and blockchain—demands constant updates to education systems. However, the lag in integrating these changes means that students often learn outdated content that is misaligned with the latest industry developments. Innovating the education system to keep pace with technological advancements and develop forward-thinking, innovative talents is a critical challenge.

4. Talent cultivation path for e-commerce majors based on industry-education collaboration

To address current issues in e-commerce education, the talent cultivation path for e-commerce majors should focus on school-enterprise cooperation, the reform of hybrid and collaborative teaching methods, and the construction of practical platforms. This path can bridge the gaps in traditional education models, ensuring students are prepared to adapt to industry changes and real-world work challenges.

4.1. Depth and breadth of school-enterprise cooperation

School-enterprise cooperation is central to the industry-education collaborative model, ensuring educational content aligns with industry needs. Currently, cooperation is mainly limited to course settings, internships, and training, hence, its depth and scope must be expanded.

Schools should invite enterprise experts to help design curricula and update content, incorporating emerging technologies, trends, and real-world applications. Enterprises can also collaborate in building practical platforms like virtual e-commerce platforms and project training bases, providing students with hands-on experience.

Additionally, the breadth of cooperation should be widened beyond internships to include the joint development of project-based courses, where students work on real-world projects during their studies. This continuous collaboration ensures that students' learning and professional skills are consistently enhanced.

4.2. Reform of hybrid and collaborative teaching methods

To meet the demands of cross-border e-commerce, teaching methods must be innovative. Traditional lecture-based methods no longer suffice for developing students' practical and innovative abilities. The hybrid collaborative teaching method, which combines traditional teaching with modern educational technologies, can fill this gap.

This method includes integrating online learning platforms, virtual simulations, and enterprise case studies to engage students in diverse learning methods outside the classroom. Enterprises should also contribute by offering industry projects and case studies, helping students apply knowledge in real-world scenarios. This approach improves students' problem-solving abilities and fosters innovative thinking.

Additionally, schools and enterprises can co-develop project-based courses, enabling students to apply theoretical knowledge to real-world problems. This method enhances students' teamwork, creativity, and professional skills, meeting the growing demand for cross-border e-commerce talent.

4.3. Joint construction of diversified training bases by schools and enterprises

Practical teaching is essential in cultivating e-commerce talent, especially in cross-border e-commerce, where hands-on skills are crucial for success. Schools and enterprises should collaborate to build diversified training bases that provide a wide range of practical opportunities.

These training bases should include not only traditional internship platforms but also virtual simulation environments, logistics platforms, and data analysis tools. These resources allow students to engage in simulated cross-border e-commerce operations, preparing them for real-world challenges.

Training bases should align closely with enterprise needs, with companies providing projects, technical support, and industry standards. This collaboration ensures that students gain exposure to cutting-edge technologies, improving their innovation and technical application skills.

5. Talent cultivation for e-commerce in the context of digital transformation

With the rapid development of global information technology, digital transformation has become a key driver of economic growth and industrial upgrading. In cross-border e-commerce, digital technologies not only enhance work efficiency but also introduce new business models and industry forms. As the e-commerce sector grows, the demand for skilled talent increases, and traditional education models must evolve to address these new

needs. In this context, the development of digital skills, innovative thinking, and cross-cultural communication abilities is essential for cultivating e-commerce professionals.

5.1. Cultivating digital skills

A core requirement for cross-border e-commerce professionals is mastering digital skills. These include proficiency in e-commerce platforms, big data analysis, AI applications, and cybersecurity. As the complexity of cross-border e-commerce increases, traditional e-commerce skills are insufficient. Students must be equipped with advanced digital tools to navigate global markets effectively.

Educational institutions should focus on integrating digital tools, online platforms, and virtual training environments into the curriculum. School-enterprise collaborations can further this by providing real-time industry data, technological applications, and innovation cases, helping students enhance their digital capabilities. This will better prepare students to handle the demands of a rapidly changing e-commerce landscape.

5.2. Cultivating innovative thinking and cross-cultural communication skills

In addition to digital skills, innovative thinking and cross-cultural communication are critical for success in cross-border e-commerce. As global market dynamics shift, companies must leverage technology, data, and innovative business models to maintain competitiveness. Cultivating innovative thinking helps students adapt to these changes and devise effective solutions to business challenges.

Cross-border e-commerce also requires communication with clients from diverse cultural backgrounds. Schools should cultivate cross-cultural communication skills by designing curricula that simulate international trade scenarios, offering cross-cultural exchange programs, and organizing international activities. These initiatives will help students interact confidently with global clients and strengthen their cross-cultural competence.

5.3. Interdisciplinary integration and cultivation of composite talents for cross-border e-commerce

Cross-border e-commerce is a multidisciplinary field, requiring knowledge not only in e-commerce but also in international trade, logistics, finance, legal regulations, and cultural understanding. Thus, e-commerce education should emphasize interdisciplinary learning, encouraging students to integrate knowledge from multiple fields.

Schools can achieve this through interdisciplinary curriculum design and project-based teaching. For example, combining international trade and e-commerce courses enables students to understand key components of cross-border e-commerce, such as trade rules, payment systems, and logistics management. Engaging in extracurricular activities and entrepreneurial practices also fosters multidimensional competencies.

In this interdisciplinary approach, school-enterprise cooperation is crucial. Enterprises can offer real-world e-commerce projects, allowing students to apply their cross-disciplinary knowledge in practical settings. This collaboration not only provides professional training but also valuable hands-on experience, helping students understand the operational complexities of cross-border e-commerce.

6. Conclusion and recommendations

With the rise of the digital economy and globalization, cross-border e-commerce has become a major driver of global trade. Traditional educational models no longer meet the fast-evolving demands of the industry.

This article explores the industry-education collaboration model as a solution for cultivating e-commerce professionals. The model includes school-enterprise cooperation to update curricula in line with industry needs, hybrid teaching methods to enhance practical skills, and multi-dimensional training bases co-built by schools and enterprises to provide real-world experience.

However, challenges remain, such as outdated curricula, shallow school-enterprise cooperation, and insufficient focus on emerging skills like digital proficiency and cross-cultural communication. The recommendations are as follows.

Curriculum updates: Schools should align curricula with the latest industry trends, adding content on digital skills, big data, and international regulations.

Deepen school-enterprise cooperation: Schools and enterprises should collaborate on course design, faculty training, and co-building training bases to offer students more practical opportunities.

Interdisciplinary Integration: Schools should encourage cross-disciplinary study to equip students with comprehensive problem-solving skills.

Cultivate innovative thinking and cross-cultural communication: Foster students' innovation and communication skills through project-based teaching and international exchanges.

In conclusion, the industry-education collaboration model bridges the gap between education and industry, producing talent that better meets market needs. Schools, enterprises, and governments must strengthen this collaboration to support the continued development of cross-border e-commerce.

Disclosure statement

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Spiritual Construction of Painting Schema: From Formal Order to Psychology

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Abstract: This paper focuses on the spiritual construction of painting schema, and probes into the transformation process from formal order to psychology. By focusing on the analysis of the formal elements in painting, such as lines, colors, composition, etc., and how to build a formal order, this paper expounds on the visual feast brought by paying attention to formal elements, and the ingenious thinking of the author behind this concept. At the same time, this paper explores how this formal order stimulates the psychological reaction of viewers, excavates the deep spiritual connotation behind it, reveals the bridge function of painting schema in connecting the spiritual world of creators and viewers, and provides a new perspective for understanding the essence and value of painting art.

Keywords: Painting schema; Formal order; Spiritual construction; Mentality

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1. Introduction

In the vast field of art, painting is definitely not only a simple blend of colors and lines but also an external reflection of the spiritual world. This paper focuses on the spiritual construction of painting icons, which just shows that our focus is on the inner world of the creator and the deep creation of exploring the essence of painting. This paper focuses on painting schema, examines and analyzes the external expression of formal order, gradually goes deep into the psychological level of creators and viewers, and analyzes how painting can arouse deep spiritual resonance through specific forms. As the external expression of painting language, painting schema hides the artist's unique way of thinking and emotional expression and also conveys multiple factors such as culture and history. Through the study of painting works in different periods and styles, this paper tries to reveal the internal relationship between painting schema and spirituality, and opens a new world for readers to understand painting art. No matter whether artists seek inspiration breakthroughs or art lovers are eager to deeply interpret their works, they can find inspiration and thinking in this paper.

2. The basic theory of painting schema and spirituality

As an important part of the art field, painting can give people beautiful visual enjoyment, whether in its external expression or its internal emotional expression and transmission. Painting schema and spirituality are two core and intertwined concepts of painting, which deeply affect artistic creation and aesthetic experience. Understanding their basic theories is the key to understanding the deep connotations of painting art. Painting schema is a basic structure or formal framework of painting, and it is the way for artists to organize picture elements. It mainly includes lines, shapes, colors, composition, and other basic elements, and these elements are combined and arranged to form works displayed by people, which is the basic language for artists to express their ideas and emotions ^[1]. From the combination of lines spontaneously formed in simple children's graffiti, to the rigorous and symmetrical composition layout in classical painting, and then to the bold subversion and innovation of traditional schema in modern art, schema runs through the development of painting. Early painting schemata are often closely linked with practical functions, such as primitive cave murals. Its simple animal image schemata originated from the social background at that time, and it has strong survival and witchcraft significance to record hunting scenes or express awe of nature. With the passage of time, in classical painting, the pursuit of schema has gradually changed, symbolizing harmony, order, and perfection. For example, in the *Mona Lisa* by the world-famous painter Da Vinci, through the pyramid-like composition schema, the characters are stably placed in the center of the picture, and the landscape in the background is displayed to the viewers according to certain painting rules, showing a unique classical aesthetic feeling and balance, and reflecting the respect for reason and order at that time. Spirituality in painting is an intrinsic meaning beyond matter and form. It is the artist's attempt to convey deep feelings, and it is the reflection of thoughts and philosophical concepts. It endows paintings with soul and vitality. Spiritual expression is one of the ultimate pursuits of painting art, which can touch the viewer's heart, arouse the emotional resonance of the viewer, and arouse more people's deep thinking about their thoughts and hearts. In different cultures and historical periods, the spirituality of painting has a variety of presentations. In medieval religious paintings, spirituality mainly conveyed the feelings of praising God and preaching religious teachings. By showing the sacred gesture of saints, painters depict auras in special ways, and actively use symbols to create a solemn, solemn and full of divinity atmosphere, and guide believers' hearts towards piety to God. In oriental paintings, especially those represented by traditional Chinese landscape paintings, spirituality is mostly manifested in the understanding and pursuit of nature and Taoism. Painters convey their reverence and love for mountains and rivers with pen and ink, and pursue a realm of "harmony between man and nature". For example, Ni Zan's landscape paintings, with only a few strokes and simple sketches, can show an ethereal and distant artistic conception, which contains the painter's deep thinking about life ^[2].

Painting schema and spirituality are closely linked and influence each other. On the one hand, the painting schema is the external carrier of spiritual expression. Artists show their spiritual world and convey beautiful feelings by choosing and creating specific schemata. For example, Picasso, a cubist painter, changed the traditional realistic schema in "*Guernica*" and constructed a chaotic picture schema with broken and distorted geometric shapes and black and white tones. In fact, he strongly accused the cruelty and evil of war and expressed his desire for peace. This unique schema made the anti-war spirit of his works vividly presented. On the other hand, spirituality drives the evolution and innovation of painting schema. Different artists have different living backgrounds and educational forms. When the artists' ideas change with time or the external environment, they will break the shackles of the traditional schema and create a new schema language. In

modern art, with social change and the development of science and technology, artists are influenced by various philosophical thoughts and social phenomena, and their spiritual pursuits are more diverse and complex. Abstract expressionist painters get rid of the description of concrete objects, and construct a brand-new schema with free and unrestrained brushstrokes and flowing and interweaving colors, aiming at expressing the subconscious and primitive emotions in their hearts and realizing the free release of the spirit. The combination of painting schema and spirituality constitutes the core of painting art. Painting schema provides a material shell for spirituality, which endows painting schema with depth and meaning. Their integration and development push the painting art to climb to new heights so that the paintings can show the rich spiritual world and the unremitting pursuit of beauty with unique artistic charm in different times, and open an artistic window to the depths of the soul for the viewer.

3. The evolution of painting schema from formal order to psychology

As the language of expression and communication by creators, painting schema has undergone a profound evolution from formal order to psychology in the course of artistic development. This change not only shows the change of artistic style through the precipitation of time but also reveals the expansion of human cognition and the spiritual world. In early painting, formal order dominated. Taking ancient Egyptian painting as an example, it follows strict stylized rules^[3]. Figures are depicted in strict accordance with a fixed proportion and posture, with the head on the side, the eyes on the front, and the body on the side. The establishment of this formal order is not without foundation, but mainly depends on the social and religious needs at that time. The ancient Egyptians also recorded the achievements and religious ceremonies of the Pharaoh through this stable and standardized painting schema, aiming at maintaining social order and inheriting beliefs. In ancient Greece, painting and sculpture pursued idealized formal beauty, built a harmonious and stable formal order based on mathematical proportion and symmetry, and showed the perfection and sacredness of the human body. At this time, the painting schema is more of a rational description of the objective world, focusing on the regularity and sense of the order of external forms to achieve visual harmony and beauty. With the change of time, medieval painting was deeply influenced by Christianity, and the formal order was endowed with religious symbolic significance. Picture composition is often centered on Christ, the characters are arranged in the same order, and the color also has a symbolic function. Gold represents sacredness, while blue symbolizes the purity of the Virgin Mary. The painting schema in this period is mainly for spreading religious teachings, guiding believers' spiritual beliefs through this schema, and leading people's thoughts and emotions to reverence and redemption for God. With the arrival of the Renaissance, the painting schema began to change. Artists re-focus on love and the real world, and based on retaining the formal order, they incorporate more expressions of characters' psychology and emotions. Leonardo da Vinci's *Mona Lisa*, through delicate brushstrokes and subtle color changes, not only shows the elegant and gentle external images of the characters but also captures her mysterious and complicated inner world. Painters began to use perspective, the contrast between light and shade, and other painting techniques to create a realistic sense of space and three-dimensionality, making the picture more appropriate to real life and giving the characters more real life and emotion. This change marks the transition of painting schema from simple formal order to focusing on the psychological expression of characters^[4].

In the period of modernism, the evolution of the painting schema became more intense. Artists are no

longer limited to imitating and reappearing the objective world but begin to gradually explore the inner spiritual world and pursue pure spiritual expression. Cubism breaks the traditional concept of time and space and formal order, decomposes and reorganizes objects, and shows the internal structure of objects and the artist's unique cognition of the world with multi-angle fragmented pictures^[5]. Picasso's "Guernica" expresses anger and protest against the war with distorted and deformed images and strong black-and-white contrast. The chaos and fragmentation in the picture just express the artist's inner spiritual world more intuitively. Expressionism, on the other hand, pays more attention to the transmission of emotions and conveys the artist's strong feelings such as pain, anxiety, and joy through exaggerated colors, lines and distorted images. In Munch's *Scream*, the distorted characters and the background full of turbulence show the loneliness and fear in human hearts without reservation.

Contemporary painting schema is in line with the formal expression of the society at that time, showing a trend of diversification and integration. Artists widely absorb various cultures, media, and concepts, and combine formal order with psychological expression in a more complex and unique way. Some artists use installation art, new media art, and other new forms to innovate the boundaries of painting, leading the audience to participate more deeply in the psychological space created by their works and experience unprecedented spiritual feelings. The schema evolution from formal order to psychology is a process of continuous breakthrough and innovation in painting art. It shows the development of human society, the change of ideas, and the deepening of artists' cognition of themselves and the world. Painting schema is no longer just a formal expression, but an important carrier of human spiritual feelings and ideas, which provides a unique perspective for us to understand the human spiritual world and cultural development.

4. Spiritual construction of painting schema: Artistic significance from form to psychology

In the field of art, the theme of "Spiritual Construction of Painting Schema: From Formal Order to Psychology" contains profound significance. It is like a key, which unlocks the mystery of understanding the essence and connotation of painting and reveals the unique value of painting art in human culture and the spiritual world from multiple dimensions.

4.1. Reveal the internal formal order of painting

Painting schema first involves formal order, which is the external structure and organizational principle of the work. From lines, shapes, and colors to composition, each element does not exist alone. They are interrelated and interact with each other to jointly construct the formal structure of the picture. For example, in classical painting, painters strictly follow the painting rules and pay attention to the principles of mathematical proportion and symmetry. For example, in Leonardo da Vinci's *Vitruvian Man*, the precise proportion of the human body and symmetrical composition reflects a harmonious formal beauty. This order gives the picture stability and rhythm, guides the audience to flow in the picture, and enables them to perceive the picture information in an orderly manner. Formal order is not only reflected in the visual effect but also the basis for artists to express their emotions. By carefully deploying painting elements, artists can control the center of gravity, rhythm, and emotional tone of the picture and build a solid framework for the transmission of spiritual connotations.

4.2. The manifestation of the spiritual world

The core of the spiritual construction of painting schema lies in the depth from formal order to the psychological level, which is the key leap for painting from material form to the spiritual realm. Form is no longer just a form, but a medium for artists to communicate with the audience. Artists integrate personal feelings, values, beliefs, preferences, and other spiritual contents into the form and show them through unique schemas. Taking Van Gogh's *Starry Moon Night* as an example, these unique formal elements show Van Gogh's restless inner world and strong desire for life, so that readers can deeply understand the thoughts and feelings behind the painting and have emotional resonance. This transformation from form to psychology makes painting go beyond the image itself and become a container carrying the human spirit, recording the spiritual tracks of different times and individuals, and connecting the souls of artists and audiences.

4.3. Reflect the spiritual meaning of the times and culture

The spiritual construction of painting schema also has epoch-making profound cultural significance. Paintings in different times and cultural backgrounds show different schema characteristics, which show the spiritual outlook, ideas, values and beliefs of the society at that time. In the religious paintings in the Middle Ages, the picture schema often showed people's reverence for God with solemn and solemn images and symbolic techniques, which reflected the dominant position of religious belief in social and spiritual life at that time. However, abstract expressionism in modern art abandons concrete objects and expresses the pursuit of individual freedom and self-exploration in a free and unrestrained form, which reflects people's rebellion against traditional order and their desire for individual liberation in industrial society. By studying the spiritual construction of painting schema, people can get a glimpse of the deep connotations of culture in different times and understand the evolution of the human spiritual world. It is like a mirror, reflecting the development and changes of social culture.

4.4. Promote artistic innovation and aesthetic development

From formal order to emotional construction, it also plays an important role in promoting artistic innovation and aesthetic development. The in-depth exploration of the spiritual construction of painting schema urges artists to break through the shackles of traditional schema and innovate formal language to express the increasingly complex spiritual world. For example, Cubist painters break the traditional single perspective, decompose and recombine objects, create a multi-dimensional schema, broaden the expression space of painting, and open up a new road for artistic development. At the same time, it also enhances the aesthetic ability of the audience, improves the empathy ability between the audience and the creator, and guides the audience to learn to dig spiritual connotation from behind the form and appreciate paintings with different styles and cultural backgrounds. When the audience understands the relationship between painting schema and spirituality, they can accept new art forms with a more open mind, expand the aesthetic boundary, and continue the vitality of art in the interaction of innovation and appreciation.

5. Conclusion

In the development of painting, the spiritual construction of schema has far-reaching significance. It is the best way for artists to show their inner spiritual world, ideas, and value implications through external sketching forms such as colors and lines, dig deep into the psychological connotation behind them, and build a framework

for spiritual expression. Through the study of the spirit of painting schema, people can better understand the artist's creative intention and also provide viewers with a perspective to deeply interpret the works. In the future, the spiritual construction of painting schema will continue to develop and inject new vitality into artistic development.

Disclosure statement

The author declares no conflict of interest.

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Application of Blended Teaching in the Reform of University Piano Course Teaching in the Network Environment

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Abstract: Blended teaching is a teaching model that integrates online and traditional teaching, leveraging the advantages of both to guide learners into deep learning. In college piano course instruction, blended teaching relies on online teaching platforms to systematically deliver piano knowledge through micro-courses, MOOCs, and other methods, providing students with more convenient and flexible learning opportunities. This approach is particularly suitable for university students with self-discipline and a proactive learning attitude. This paper explores the feasibility of combining the characteristics of the piano discipline with MOOC teaching, emphasizing the reform of teaching methods through online open courses to promote a student-centered learning model. This allows students to acquire piano performance skills more independently. Additionally, the paper analyzes contemporary university students' learning habits, highlighting that online learning has become a more suitable learning pathway compared to traditional classrooms, further supporting the value of blended teaching in college piano courses.

Keywords: Blended teaching; College piano course; MOOC; Online open courses; Teaching reform

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1. Introduction

With the rapid development of information technology, higher education is undergoing a profound transformation in teaching models. Blended teaching, which integrates the advantages of traditional classroom instruction and online learning, has become a crucial trend in higher education reform. In college piano courses, traditional teaching methods are often constrained by class time, faculty resources, and teaching space, making it difficult to meet students' needs for personalized and self-directed learning. The introduction of blended teaching provides a more flexible and targeted learning environment, enabling students to acquire theoretical knowledge through online courses while engaging in hands-on practice and in-depth discussions in

the classroom, thereby optimizing learning outcomes. The teaching objectives of college piano courses extend beyond piano performance skills to include music theory, improvisation, and musical expressiveness, making innovation in teaching methods particularly essential. By leveraging digital educational resources such as MOOC, micro-courses, and online open courses, blended teaching allows students to engage in self-directed learning based on their individual needs and progress ^[1]. At the same time, instructors can use online resources to supplement classroom instruction, employing flipped classroom strategies to enhance interaction, increase student engagement, and boost learning motivation. Against this backdrop, this paper explores the application value and practical models of blended teaching in college piano courses, analyzes its advantages and challenges, and proposes strategies for optimizing teaching, aiming to provide theoretical foundations and practical guidance for the reform of piano course instruction in higher education.

2. Exploration of the blended teaching model based on the characteristics of the piano discipline

As an essential component of music education in higher education, piano courses aim not only to develop performance skills but also to cover music theory, harmony analysis, musical interpretation, and improvisation. Therefore, a single classroom-based lecture model often fails to meet students' systematic learning needs in piano education. The blended teaching model integrates the interactivity of traditional instruction with the flexibility of online learning, enabling students to receive more targeted instructional support at different stages of their learning process ^[2].

2.1. The comprehensive nature of the piano discipline and the compatibility of blended teaching

Piano instruction involves a substantial amount of music theory knowledge, such as music theory fundamentals, harmony, and form analysis, while also relying heavily on students' practical performance abilities. Traditional teaching models are typically centered on teacher-led classroom instruction, where students engage in limited in-class practice and rely on self-study after class for reinforcement. In contrast, blended teaching leverages online platforms to provide micro-courses (Microlectures) or Massive Open Online Courses (MOOC), allowing students to independently learn theoretical concepts before class, while in-class sessions focus on practicing performance techniques and interactive learning. For example, when teaching "Analysis of Piano Work Styles", instructors can upload representative works from different musical periods onto an online platform, accompanied by explanatory analysis videos. Students can watch these materials and complete related exercises before class. During in-class sessions, teachers can then focus on guiding students in mimicking various playing styles and engaging in in-depth discussions that integrate harmony analysis, musical structure, and stylistic characteristics ^[3]. This approach not only enhances teaching efficiency but also strengthens students' self-directed learning abilities.

2.2. Advantages of MOOC teaching in piano courses

Massive Open Online Courses (MOOC) are large-scale online courses characterized by systematic content, self-paced learning, and abundant resources. Introducing MOOC into college piano instruction can fully leverage these advantages to improve both teaching quality and learning efficiency. Firstly, MOOCs can break down complex theoretical and technical aspects of piano courses into short video segments with

accompanying quizzes, allowing students to progressively master key concepts, thereby enhancing learning outcomes. Second, MOOCs offer opportunities for repeated learning, addressing the limitations of traditional classroom instruction ^[4]. In conventional teaching models, if students struggle to understand a concept, they often have to wait until the next class to seek clarification from their instructor. However, with MOOC, students can rewatch lessons anytime, enabling them to reinforce learning until they fully grasp the material. Additionally, MOOC optimize teaching resource allocation by addressing the faculty limitations in college piano education. They allow students from different regions to access high-quality instructional content, thereby improving the overall equity and quality of piano education. **Table 1** compares traditional piano teaching models with blended teaching models.

Table 1. Comparison between traditional piano teaching and blended teaching models

Comparison dimension	Traditional piano teaching model	Blended teaching model
Knowledge acquisition method	Teacher-centered lectures	Online micro-courses and offline hands-on interaction
Time flexibility	Fixed class schedules	Flexible online learning and adaptive offline guidance
Error correction mechanism	Relies on real-time in-class feedback	AI-based intelligent assessment and multidimensional feedback
Resource coverage	Primarily limited to faculty within the institution	Global expert courses and cross-institutional resource-sharing
Practice intensity	45 minutes of daily in-class practice	72 minutes of daily blended learning (online and offline)
Interest alignment	Standardized teaching content	Personalized learning pathways

2.3. Optimized teaching pathways through the integration of theory and practice

In the blended teaching model, the instructional design of piano courses can adopt an “online theoretical learning and offline practical training” approach. For instance, when teaching “Application of Harmonic Progressions in Piano Performance”, students can first learn fundamental harmony theories through MOOC courses, then practice using virtual keyboard software, and finally receive face-to-face guidance and corrections from instructors during in-class sessions ^[5]. This teaching approach ensures that students receive targeted support at different learning stages, ultimately improving learning outcomes. Furthermore, research has shown that adopting a blended teaching approach significantly enhances students’ classroom engagement and self-directed learning abilities.

In summary, considering the characteristics of the piano discipline, the integration of blended teaching and MOOC effectively improves teaching quality. It allows students to enhance their piano performance skills and musical literacy in a flexible and efficient learning environment. This teaching model not only optimizes the instructional design of college piano courses but also provides an innovative direction for the future of music education.

3. Research on the empowerment of college piano teaching through online open courses

3.1. Optimizing teaching content to enhance learning efficiency

The curriculum of college music programs is extensive, with piano instruction encompassing not only a

significant amount of performance practice but also related subjects such as music theory, harmony, and ear training. However, due to time constraints in classroom teaching, instructors often struggle to cover all essential knowledge points in detail, making it difficult for some students to fully absorb and process the material. The introduction of online open courses can effectively address this issue. Firstly, online open courses can modularize piano teaching content, breaking down complex theoretical concepts and performance techniques into concise and structured teaching videos, enabling students to gradually master the material at their own learning pace^[6]. For example, a course on piano pedal techniques can be divided into multiple videos covering topics such as “Basic Usage of the Sustain Pedal”, “Half-Pedaling Techniques”, and “The Relationship Between Pedals and Harmony” allowing students to focus on specific aspects according to their needs. Additionally, online courses are often equipped with quizzes, assignments, and feedback systems, helping students assess their learning progress, identify gaps, and build a more comprehensive knowledge framework. Furthermore, online open courses provide personalized learning pathways. Depending on students’ skill levels, courses can be categorized into “Beginner Piano Fundamentals”, “Intermediate Technique Improvement”, and “Advanced Performance and Interpretation” to offer students targeted learning experiences that align with their individual needs and enhance overall efficiency.

3.2. Promoting the sharing of teaching resources and expanding learning opportunities

Traditional piano teaching is often constrained by the faculty strength and teaching resources available at a given institution. High-level piano courses are typically limited to a select number of prestigious universities, making it difficult for students at regular institutions to access the same quality of education. However, the promotion of online open courses removes these geographical and institutional limitations, allowing high-quality educational resources to be shared on a broader scale^[7]. Firstly, online open courses provide students with access to world-class piano instruction. Piano courses from top domestic and international music academies can be made available to global learners through open course platforms. For instance, performance demonstration courses recorded by renowned pianists and music educators allow students, regardless of their institution, to receive high-quality piano education. Secondly, the shared nature of open courses facilitates inter-university teaching exchange. Universities can collaborate on course resources, learn from each other’s teaching experiences, and continually optimize piano education systems. For example, a university could partner with a renowned international music institution to co-develop online courses, exposing students to a broader musical education perspective. Additionally, online open courses can integrate with social learning platforms, providing students with more interactive learning opportunities. Students can participate in course discussion forums, engage with global learners, share learning insights and performance experiences, and even collaborate on remote ensemble performances, thereby enhancing the social and practical dimensions of music learning.

3.3. Promoting innovation in teaching models and achieving student-centered learning

For a long time, traditional piano teaching has primarily relied on a lecture-based classroom model, where teachers deliver knowledge within a fixed schedule, and the content is largely teacher-driven, leaving students with limited opportunities for self-directed learning. However, the promotion of online open courses has gradually shifted college piano teaching towards a student-centered model, encouraging students to actively participate in learning and improving classroom interaction and practical engagement^[8]. Online open courses support the flipped classroom model. In this approach, students can independently learn piano theory through

online courses before class, while classroom time is primarily dedicated to performance practice, discussions, and personalized guidance. For example, students can watch a music analysis course on Bach's The Well-Tempered Clavier before class, then discuss different performance interpretations with their instructor and engage in practical playing exercises, receiving personalized feedback from the teacher. This model makes more efficient use of classroom time and enhances teaching effectiveness. Online open courses enhance students' ability to learn autonomously. Students can freely choose learning content, set their own learning pace, and explore different piano performance styles based on their interests. Some students may be interested in classical piano, while others may prefer jazz or pop piano. Online open courses cater to these diverse preferences, offering more flexible learning options. Additionally, most course platforms feature progress-tracking functions, allowing students to monitor their learning through assessments and progress reports and adjust their study plans accordingly to ensure they meet their learning objectives. The interactive features of online open courses further drive teaching innovation. Teachers can utilize discussion forums and live Q&A sessions on online course platforms to engage in real-time interactions with students and address any learning difficulties they encounter. At the same time, automated assessment functions on these platforms can intelligently analyze students' performances and provide instant feedback, helping them accurately refine their playing techniques.

4. Analysis of the compatibility between online teaching and students' learning habits

4.1. Increasing dependence on the internet among students

With the widespread adoption of smartphones, tablets, and other mobile devices, modern university students have become significantly more dependent on the internet for learning. Whether outside the classroom or in daily life, students increasingly prefer to obtain information, look up materials, and watch instructional videos online. In piano learning, traditional classroom instruction is often constrained by time and space, limiting students' opportunities for review and practice after class. MOOC teaching platforms effectively overcome these limitations by allowing students to access course content at any time, watch instructional videos, and engage in self-directed learning. This convenience makes MOOC an essential tool for adapting to students' learning habits, especially in practice-intensive disciplines such as piano. Through these platforms, students can learn new techniques and theoretical knowledge from video courses and repeatedly practice in their fragmented free time, significantly improving learning efficiency ^[9].

4.2. Demand for self-directed and personalized learning

Modern university students generally possess strong self-directed learning abilities. Unlike traditional teacher-led instructional methods, MOOCs provide greater autonomy, allowing students to select course content based on their interests and needs while managing their own learning pace. This characteristic is particularly significant in piano education, as learning the instrument requires long-term accumulation, with students needing to choose appropriate learning content and progress according to their personal interests and abilities. Through MOOC platforms, students can select courses of appropriate difficulty based on their actual skill level, ranging from fundamental music theory to advanced piano techniques, enabling them to learn at their own pace in a personalized manner. Moreover, MOOC learning resources are not limited to a single textbook or classroom lecture but incorporate diverse formats such as videos, audio recordings, and e-books, providing a comprehensive range of study materials that help students understand and master piano techniques from

multiple perspectives. By selecting suitable learning resources according to their specific needs, students can enhance both their autonomy and the effectiveness of their learning ^[10].

4.3. Enhanced interactivity and feedback mechanisms

Traditional piano instruction often relies on face-to-face interaction between teachers and students. However, due to time and space constraints, it is difficult to provide each student with sufficient individualized attention during class. MOOC teaching platforms address this limitation by offering enhanced interactivity and feedback mechanisms, allowing students to receive timely assistance and guidance throughout their learning process. On MOOC platforms, students can not only watch pre-recorded instructional videos but also participate in online discussions, ask questions, and even upload their own performance videos for evaluation by instructors and peers. Teachers can also assess students' learning progress through online assignments and quizzes, providing personalized feedback and recommendations based on their performance. In piano education, where technical proficiency requires continuous practice and immediate feedback, the interactive features of MOOC platforms enable students to upload their performance videos at any time and receive targeted guidance from instructors ^[11]. This allows students to correct mistakes through practice while also gaining valuable insights into musical expression and technical nuances. Additionally, the social features of MOOC platforms facilitate knowledge-sharing among students, enabling them to learn from each other's experiences and fostering a greater sense of engagement and belonging.

Table 2. Comparison of teacher and student roles in blended teaching

Teaching aspect	Traditional teaching roles and behaviors	Blended teaching roles and behaviors
Knowledge delivery	Teacher provides one-way lectures → Students passively listen	Teacher designs the curriculum → Students choose learning paths independently
Skill training	In-class demonstration → Self-practice after class	AI-assisted error correction → Targeted teacher guidance → Peer evaluation
Feedback and assessment	Final performance exam and paper-based tests	Real-time data tracking and multidimensional evaluation (system/teacher/student)
Innovation development	Dependent on teacher's personal teaching style	Cross-institutional creative community and virtual ensemble projects

4.4. Compatibility of Fragmented Learning Mode

Modern university students generally have tight schedules, with extracurricular activities, internships, and part-time jobs taking up a significant portion of their time. In this context, fragmented learning has become an efficient way to study. The MOOC teaching model fully accommodates this need, allowing students to access instructional videos at any time and utilize any available fragmented time for learning. For example, students can continue practicing piano techniques and studying music theory through short learning modules while commuting on public transport, during lunch breaks, or before bedtime. Unlike traditional classroom-based learning, which requires long, continuous study sessions, MOOC platforms design their courses to be concise and focused, emphasizing key concepts and core content. Each video lesson can be completed independently, enabling students to arrange their learning progress flexibly based on their available time. Piano learning inherently requires extensive practice, and MOOC platforms break down learning content into small units, delivering instruction through short videos and practice tasks. This approach allows students to make use of

fragmented time for study and practice, improving learning efficiency while reducing procrastination and interruptions in the learning process.

5. Conclusion

The application of the blended teaching model in college piano courses fully utilizes the advantages of information technology and traditional educational methods, promoting the modernization of teaching content and innovation in teaching approaches. Through MOOC, micro-courses, and online open courses, piano education can overcome the limitations of time and space, providing students with a more personalized and flexible learning experience. The core value of blended teaching lies in its ability to integrate theory with practice, reinforcing students' understanding of piano theory while allowing for repeated practice and real-time feedback through online platforms to enhance performance skills. Given that contemporary university students exhibit strong self-learning abilities and a high dependence on digital resources, MOOC and other online learning tools offer them greater flexibility and choice, fostering a student-centered learning approach. However, the implementation of blended teaching still faces certain challenges, such as how teachers can effectively design online and offline course content and how to balance technology with teaching quality. Therefore, future improvements in the blended teaching model should include greater investment in teacher training, enhancements in platform interactivity and feedback mechanisms, and better alignment with students' learning needs ^[12]. Additionally, refining teaching content, integrating and sharing course resources, and diversifying learning methods will be key directions for the future reform of piano education.

In summary, the blended teaching model not only enhances the teaching efficiency of college piano courses but also drives continuous innovation in educational methods and technological approaches. It provides students with a more autonomous and personalized learning experience while offering new perspectives and practical pathways for the reform and development of piano education.

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Evaluation of Talent Training Goals Achievement Based on the Analysis of Curriculum Examination Points Distribution

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Abstract: This study explores a new approach for evaluating teaching quality in higher education based on the analysis of examination point distribution in courses. The aim is to assess the alignment between course teaching objectives and talent cultivation goals through quantitative indicators. Using 122 professional courses from a university in southwest China as the subject, the study introduces indicators such as course teaching objective examination point coverage, question bank examination point coverage, and examination paper examination point coverage to analyze the achievement of knowledge, ability, and quality three-dimensional goals. The results show that the coverage of knowledge goals is relatively high, while the coverage of ability and quality goals is low, reflecting deficiencies in course design regarding ability training and quality education. Additionally, there are significant differences in the conversion between examination papers and question banks, and the coverage of assessment points is uneven in some courses. Based on the research findings, this paper proposes suggestions for optimizing course design, improving question bank construction, and building an academic monitoring system, providing theoretical and practical references for improving teaching quality in higher education.

Keywords: Course examination point distribution; Teaching goal achievement; Examination point coverage; Teaching quality evaluation; Talent cultivation goals

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1. Introduction

In recent years, with the rapid development of higher education, teaching quality evaluation has become a crucial guarantee for universities to achieve their talent cultivation goals. Domestic scholars have conducted extensive research on the achievement of course objectives and teaching quality evaluation. Li Zhiyi proposed how to determine training objectives and graduation requirements, identify key indicators, construct a curriculum system, and develop a teaching syllabus from the perspective of Outcomes-Based Education (OBE)

^[1]. Jiang Dawei and Liu Limin explored the concept based on OBE, emphasizing that student quality is the core measure of educational outcomes. They optimized the teaching outline by clarifying course objectives and decomposing evaluation indicators to improve teaching quality ^[2]. Jin Lina and Hu Wenjin constructed a data-driven teaching quality evaluation system in their study titled “Research on the Construction of a Teaching Quality Evaluation System for Universities Based on Big Data Technology.” They highlighted the importance of data support in evaluation, providing a practical reference for analyzing the distribution of examination points ^[3]. Hu Xingzhi and Liu Weijia explored new methods of teaching quality evaluation based on big data in their study “Exploration of Higher Education Quality Evaluation Based on Big Data” ^[4].

Current research primarily focuses on outcomes-based course teaching evaluation, emphasizing course objectives, weight distribution, and the construction of evaluation systems. However, these studies have paid less attention to the direct impact of examination point distribution on the achievement of teaching objectives, especially the correlation between examination point coverage and the three-dimensional goals of knowledge, ability, and quality. This paper explores an evaluation method based on the analysis of course examination point distribution to assess the achievement of talent cultivation goals. By introducing indicators such as examination point coverage, it evaluates the achievement of course teaching objectives from multiple dimensions. Furthermore, it analyzes the relationship between the distribution of examination points and the overall teaching effectiveness, proposing targeted improvement suggestions to provide theoretical and practical references for universities to enhance teaching quality.

2. Research objects, indicators, and methods

2.1. Research objects

This study analyzes the teaching archives and assessment data of 122 professional courses from a university in southwest China, covering various course types such as medicine, social science, and rehabilitation, including both compulsory and elective courses, which provide good representation. The research focuses on aspects such as the coverage rate of course teaching objectives’ examination points, the coverage rate of examination paper’s examination points, and student performance.

2.2. Research indicators

Course objectives refer to the specific goals that a course aims to achieve. They serve as an essential basis for designing course content, implementing teaching processes, and evaluating courses ^[5]. As the core guiding element of teaching activities, course teaching objectives represent the learning outcomes that teachers expect students to achieve during the teaching process. They not only mark the starting point of instructional design but also constitute a crucial foundation for assessing teaching effectiveness. Teaching objectives are typically divided into three dimensions: knowledge objectives, ability objectives, and quality objectives. These correspond to students’ mastery of knowledge, enhancement of abilities, and cultivation of comprehensive qualities, respectively ^[6]. Courses form an integral part of professional talent cultivation, and their teaching objectives directly support the overall talent cultivation goals ^[7]. Specifically, course teaching objectives are the concretization of talent cultivation goals, while chapter teaching objectives further elaborate and support the course objectives. Chapter teaching objectives can be linked to examination points, which are then shaped into assessment content through the construction of a question bank. Finally, student scores are generated through

the assembly of examination papers and the conduct of examinations (**Figure 1**).

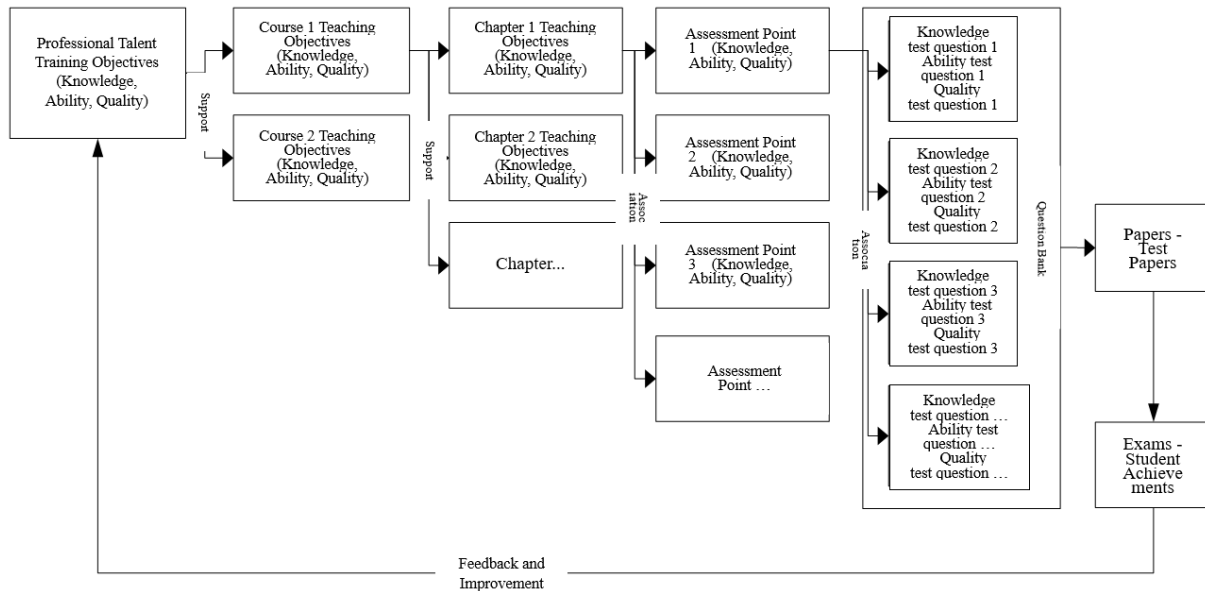


Figure 1. Complete closed-loop flowchart from talent cultivation goals to student performance feedback

Based on the requirements of the talent cultivation program and the characteristics of course teaching design, this study selects the following key indicators.

Course teaching objective examination point coverage rate: Measures the degree of alignment between course objectives (knowledge, ability, quality) and specific examination points, assessing the achievement of teaching goals.

Question bank examination point coverage rate: Analyzes the coverage of key examination points in the course by the questions in the question bank, reflecting the comprehensiveness and pertinence of the question bank.

Examination paper examination point coverage rate: Evaluates the coverage of key examination points in the course by the final examination paper, examining the rationality of the examination paper design.

Student performance statistics: Includes average score, highest score, lowest score, and score variance, comprehensively reflecting teaching effectiveness and student learning outcomes.

The calculation formulas for the above indicators are as follows:

Course teaching objective examination point coverage rate (knowledge) = Number of course teaching objectives associated with examination points (knowledge) / Total number of course objectives (knowledge)

Course teaching objective examination point coverage rate (quality) = Number of course teaching objectives associated with examination points (quality) / Total number of course objectives (quality)

Course teaching objective examination point coverage rate (ability) = Number of course teaching objectives associated with examination points (ability) / Total number of course objectives (ability)

Question bank examination point coverage rate = Number of examination points associated with all questions in the question bank / Total number of examination points in the course

Examination paper examination point coverage rate = Number of examination points covered by all questions in the examination paper / Total number of examination points in the course

2.3. Research methods

This study employs statistical analysis and data mining methods, following the steps below.

Examination point correlation analysis: Quantitative analysis is used to calculate the examination point coverage rate for each teaching objective, evaluating the scientific nature of course design.

Horizontal comparison: Compares the coverage situation across different courses, revealing data distribution characteristics.

Factor correlation: Explores the correlation between examination point coverage rate and student performance, analyzing the actual effectiveness of teaching objective achievement.

3. Results and discussion

3.1. Analysis of examination point coverage rate for course teaching objectives

3.1.1. Overall coverage rate analysis

Based on the statistical results in **Table 1**, the examination point coverage rate for course teaching objectives exhibits the following characteristics.

The average coverage rate for knowledge objectives is 91.47%, with 90.16% of courses having a coverage rate above 75%. This indicates that the course design is relatively comprehensive in terms of knowledge imparting, and core knowledge points are well covered.

The average coverage rate for ability objectives is 63.65%, with 18% of courses having a coverage rate below 50%. This suggests that the ability training objectives need to be further strengthened.

The average coverage rate for quality objectives is 55.91%, and 63.11% of courses have a coverage rate below 50%. This reflects the current insufficient emphasis on quality education in course design, and the assessment content for quality objectives is relatively weak.

3.1.2. Coverage rate analysis by course type

Based on the analysis of teaching objective coverage rates for different course types in **Table 2**, the following conclusions are drawn.

Medical courses have the most systematic and stable teaching objectives. The knowledge objective coverage rate ranges from 90%–100%, with a low coefficient of variation (0.12). The coverage rates for ability and quality objectives are relatively concentrated with small fluctuations, and the coefficients of variation are 0.25 and 0.4, respectively.

Social science courses show the greatest variability in teaching objectives. The knowledge objective fluctuates significantly (80%–100%), with a high coefficient of variation (0.75), indicating instability. There are notable differences in the coverage rates for ability and quality objectives, suggesting a lack of consistency and stability in course design.

Rehabilitation courses have a relatively balanced knowledge objective coverage rate (80%–100%). The ability objective shows moderate fluctuation (50%–100%) with a moderate coefficient of variation (0.60). The quality objective coverage rate varies considerably, indicating a need for further optimization in course design.

3.1.3. Discussion

The low coverage rate for quality objectives implies that the current course assessment methods are inadequate to fully reflect students' comprehensive ability development. It is recommended that course designers

incorporate more content related to quality education when setting teaching objectives and enhance its representation in assessments to improve the comprehensiveness and balance of the courses.

For courses with a low coverage rate for ability objectives, it is suggested to increase practical components and adopt diversified evaluation methods to enhance students' comprehensive ability development. Regarding the high variability in social science courses, it is recommended to unify the teaching objective setting standards to ensure consistency and stability in course design.

Table 1. Overall statistics of examination point coverage rate for course teaching objectives

Goal type	Average coverage rate	Maximum coverage rate	Minimum coverage rate	Coverage distribution
Knowledge goal	91.47%	100%	40%	90%–100%:85courses 75%–90%:25courses <75%:12courses
Ability goal	63.65%	100%	0%	90%–100%:35courses 50%–90%:65courses <50%:22courses
Quality goal	55.91%	100%	0%	90%–100%:courses 50%–90%:courses <50%:courses

Table 2. Comparative analysis of teaching objectives coverage and coefficient of variation for course types

Goal type	Knowledge goal	Ability goal	Quality goal	Coefficient of variation of knowledge objectives	Coefficient of variation of ability objectives	Coefficient of variation of quality objectives
Medical courses	Most stable (90%–100%)	Relatively concentrated (70%–100%)	Basically controllable (50%–100%)	0.12	0.25	0.4
Social science courses	More volatile (80%–100%)	Significantly variable (0%–100%)	Highly uncertain (0%–100%)	0.08	0.5	0.75
Rehabilitation courses	Relatively balanced (80%–100%)	Moderately volatile (50%–100%)	Large variance (0%–100%)	0.06	0.2	0.60

3.2. Correlation analysis between course assessment points and question bank, examination papers

3.2.1. The overall design quality of the question bank is high

The coverage rate of question bank assessment points refers to the analysis of the question bank's coverage of the main assessment points of the course, reflecting the comprehensiveness and pertinence of the question bank. According to **Table 3** and **Table 4**, the average coverage rate of question bank assessment points is 94.71%, with 91.80% of courses having a coverage rate above 85%, indicating that the question bank design for most courses is relatively complete and can cover the core knowledge points of the courses. Only one course (0.82%) has a coverage rate below 60%, which requires focused optimization to ensure that the question bank can fully cover the core knowledge points of the course.

Table 3. Data table of course assessment point coverage rate

Index	Question bank test center coverage rate	Volume A test center coverage rate	Volume B test center coverage rate
Average	94.71%	68.11%	69.39%
Maximum value	100%	96%	96%
Minimum value	50%	0%	0%

Table 4. Question bank test center coverage interval and proportion

Interval	Number of courses	Proportion
<60%	1	0.82%
60%–85%	9	7.38%
>85%	112	91.80%

3.2.2. The overall performance of the test paper assessment point coverage is acceptable

According to **Table 5**, the coverage rates of Test A and Test B are mainly concentrated between 60%–85% (59.84% for Test A and 61.48% for Test B), indicating an acceptable overall performance, but there is still room for optimization. Some courses have lower coverage rates, with 13.11% and 11.48% of courses having coverage rates below 35% in Test A and Test B, respectively. Four courses (3.28%) have no assessment point coverage, mainly adopting comprehensive assessment forms such as research reports and small papers, which are not directly related to assessment points.

Courses without assessment point coverage (such as New Ethics) mainly adopt non-traditional examination forms (such as research reports, small papers, etc.), resulting in the assessment point coverage rate not being directly reflected. This indicates that: (1) For courses with different examination methods, there are deficiencies in the design of propositions, and the assessment content and assessment points are not effectively combined. (2) It is necessary to explore new proposition strategies that combine comprehensive assessment forms with assessment point coverage to ensure that the assessment content fully covers the core knowledge points of the course.

Table 5. Average, range, and proportion of test paper assessment point coverage

Index	Volume A test center coverage rate	Volume B test center coverage rate
No assessment point coverage	3.28% (4 courses)	3.28% (4 courses)
35% or less	13.11% (16 courses)	11.48% (14 courses)
35%–60%	19.67% (24 courses)	20.49% (25 courses)
60%–85%	59.84% (73 courses)	61.48% (75 courses)
85% or more	4.10% (5 courses)	3.28% (4 courses)

3.2.3. Significant differences exist in the conversion between test papers and question banks

According to **Table 3**, the average assessment point coverage rates of the test papers (Test A and Test B) are 68.11% and 69.39%, respectively, which are significantly lower than the coverage rate of the question bank. This indicates that: The design of the test papers did not fully utilize the resources of the question bank, and

there may be issues such as uneven selection of assessment points or unreasonable proposition design. There are too many assessment points designed in the question bank construction, resulting in incomplete coverage by the test papers, and some assessment points are not reflected in the test papers.

3.2.4. Differences exist between course types

Medical courses have relatively high coverage rates for both the question bank and test papers, indicating that the teaching and evaluation systems for these courses are relatively mature.

The test paper coverage rate for rehabilitation courses fluctuates greatly, and some courses (such as Rehabilitation Psychology) have very low coverage rates, indicating that the evaluation system for these courses needs improvement (**Table 6**).

Social science courses have a high coverage rate for the question bank, but the test paper coverage rate varies greatly, indicating that the evaluation system for these courses needs further standardization.

Table 6. Course type coverage rate

Goal type	Question bank coverage range	Test paper coverage range
Medical courses	90%–100%	60%–90%
Social science courses	82%–100%	50%–80%
Rehabilitation courses	85%–100%	40%–90%

3.2.5. Discussion

Through the above analysis, it can be found that the overall performance of the test paper assessment point coverage is acceptable, but there are still issues such as uneven coverage, low coverage in some courses, and insufficient connection between the test paper and the question bank. The existence of these problems not only affects the comprehensive achievement of teaching goals but also exposes the deficiencies in the design and implementation of the evaluation system. By clarifying the improvement direction to enhance teaching quality, identifying the root causes of the problems, and proposing targeted optimization measures, the scientificity and rationality of test paper design can be effectively improved, further promoting the overall improvement of teaching quality^[8].

3.3. Analysis of student performance and achievement of talent cultivation goals

The statistical indicators of student performance focus on average scores, highest scores, lowest scores, and score variance (**Table 7**). These indicators can comprehensively reflect the effectiveness of teaching implementation and students' learning status. Through statistical analysis of the scores of 203 classes and 80 courses across 3 majors and 3 grades in the school, the following conclusions are drawn.

The overall performance of the social work major is good, with average scores ranging from 79.68 to 92.58, the highest score being 99, and the lowest score being 50. Some courses (such as “Planning and Organization of Activities for the Elderly”) show significant differences in scores, requiring attention to the distribution of student scores. For courses with low average scores and high variance (such as “Introduction to Management”), teaching support and assessment design can be strengthened.

The overall performance of the health service and management major is relatively stable, with average

scores concentrated between 81.03 and 93.88, the lowest score being 57, and the highest score being 97. Individual courses (such as “Introduction to Traditional Chinese Medicine”) have a large variance, reflecting significant differences in student scores. For courses with large variances (such as “Introduction to Traditional Chinese Medicine”), it is necessary to optimize teaching content and assessment methods to narrow the gap in student scores.

The nursing major has the largest number of courses, with average scores fluctuating significantly (76.04 to 95.86), the highest score being 100, and the lowest score being 0. Some courses (such as “Critical Care Nursing”) have extremely high variances, requiring special attention. For courses with extremely high variances (such as “Critical Care Nursing”), it is necessary to analyze the problems in teaching and assessment to ensure a reasonable score distribution.

Table 7. Statistical analysis of scores for 80 courses

Professional	Grade	Number of courses	Average score range	Variance range	Highest score range	Lowest score range
Social work	Grade 1	7	79.68–92.58	10.93–34.74	89–99	66–83
	Grade 2	6	82.46–87.46	5.18–17.39	87–93	71–82
	Grade 3	8	79.86–91.09	16.06–78.88	89–97	50–74
Health services and management	Grade 1	4	81.03–91.42	33.33–47.40	90–97	61–75
	Grade 2	7	83.82–91.32	5.58–102.58	91–97	57–85
	Grade 3	8	81.64–93.88	3.31–30.55	90–97	67–91
Nursing	Grade 1	6	78.36–90.43	8.20–101.38	90–97	19–67
	Grade 2	14	75.93–92.91	9.06–123.52	95–99	28–68
	Grade 3	20	76.04–95.86	3.68–432.83	83–100	0–86

Overall, the distribution of student scores can reflect the achievement of teaching goals, but it also exposes the deficiencies in the teaching design and assessment methods of some courses. By optimizing teaching content, improving assessment methods, and strengthening teaching support in a targeted manner, educators can further enhance students’ learning effects and promote the comprehensive realization of talent cultivation goals.

4. Suggestions for improving teaching quality

Based on the research results, the following measures and suggestions for other universities are proposed. Optimize course design and increase the proportion of quality education. Course objectives need to comprehensively cover the three dimensions of knowledge, ability, and quality, avoiding emphasis on a single dimension. Strengthen the cultivation of students’ teamwork and innovative spirit from course design and goal setting^[9]. Improve the construction of the question bank. Increase the matching degree between the quality of the questions in the question bank and the assessment points to ensure the practicality of the teaching goals. Build a monitoring and feedback system for academic conditions and improve the student support system. Through accurate score data analysis, identify teaching problems, and reduce the polarization of scores through tutoring courses and dynamic academic analysis. Strengthen the teaching quality monitoring system. Use data analysis methods to comprehensively monitor the achievement of teaching goals and resource investment.

5. Research significance and prospects

Based on the analysis of course assessment point distribution, this study proposes a new path to measure the achievement of teaching goals, providing innovative references for teaching quality evaluation in universities. By constructing a coverage evaluation system, key issues in course design and implementation can be more clearly diagnosed, such as low coverage of quality objectives, imbalanced distribution of assessment points, and insufficient connection between test papers and question banks. This method has high universality and is suitable for the course quality evaluation system of other universities, promoting cross-campus scientific research and teaching data sharing. At the practical level, this analytical approach not only helps schools clarify the direction of teaching quality improvement but also promotes the deep integration of teaching goals and actual talent cultivation needs. In addition, constructing a systematic data collection and analysis framework provides experience for the construction of intelligent and data-driven teaching quality platforms in universities, thus better serving the growth of schools and students in the future. In the future, research should combine qualitative analysis to extend the situation of teachers' teaching behavior and students' learning experience, and expand the sample scope to cover more schools and undergraduate majors, providing more comprehensive academic support for improving the teaching quality of the entire higher education system.

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An Investigation of Professional Identity of Elementary Education Major Students in Normal Schools Based on Identity Theory

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Abstract: In the field of education, the professional identity of primary education students is of great significance to their future education practice and education quality improvement. Based on the identity theory, this study conducted an in-depth investigation of the professional identity of primary education students by using questionnaires, interviews and other methods. Through the analysis of data, explore the factors that affect their professional identity. Combined with the theoretical model of self-identity, the paper analyzes the causes and specific phenomena of four kinds of identity states of normal university students' professional identity. This study provides the theoretical basis and practical reference for improving the vocational identity of normal college students, which is helpful in promoting the sustainable development of primary education.

Keywords: Normal university students; Professional identity; Identity theory

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1. Question raising and research background

Teacher professional identity refers to the process of teachers' continuous development and growth in the field of education, and then gradually determining and confirming their role and the degree of identification of their specific profession^[1]. For normal university students, it is a compulsory course from the status of prospective teachers to formal teachers, and it is also the inner driving force for normal university students to achieve self-growth and development. Normal university students' attitudes towards the teaching profession are related to their learning effect in school, the adequacy of pre-service preparation, and their future professional behavior^[2].

First of all, having a high teacher professional identity can greatly promote the cultivation and improvement of normal university students' professional skills. If normal students have a high degree of professional identity, it will be converted into internal motivation, prompting them to be more focused and emotionally involved

in learning professional skills ^[3]. Secondly, the higher professional identity of teachers can help normal students enhance their sense of occupation and responsibility. The sense of responsibility of teachers comes from the firm belief in the profession of teachers, the concept of education, and the deep understanding of the responsibility of education ^[4]. In addition, a higher professional identity of teachers can help normal students overcome difficulties and fear of difficulties, and thus achieve a long career. Teachers with a good and positive professional attitude can immerse themselves in the inner fun and happiness of education work, experience the sense of achievement and satisfaction brought by occupation, and obtain an inexhaustible source of stimulation for a happy mood ^[5]. In addition, the high professional identity of teachers can create a positive educational atmosphere, attract more people to join the cause of education, promote the prosperity of the cause of education, and provide a talent guarantee for social progress. Therefore, for normal university students, improving a teacher's professional identity is one of the important tasks in their prospective teacher stage.

However, the empirical investigation of the professional identity of primary education students found that their overall degree of professional identity is not high. The main reasons are the low salary of teachers, the lack of teaching practice activities and the lack of timeliness of vocational belief cultivation ^[6]. Lack of professional identity will affect normal university students' learning enthusiasm and future career planning and even make it difficult for them to adapt and persist after entering the workplace. Therefore, training colleges and universities should improve the curriculum system of normal education and formulate effective talent training programs ^[7]. At the same time, normal university students themselves should also take the initiative to enhance their professional identity, make full use of the practical activities organized by colleges and universities, and feel and reflect on the practice ^[8]. The purpose of this paper is to investigate and analyze the current situation of professional identity of teachers of normal college students in primary education, and put forward some suggestions on how to cultivate their professional identity.

2. Research methods

Questionnaires and interview methods were used in this study. The questionnaire method aims to comprehensively collect data information on professional identity and related factors of normal university students. The questionnaire design covers multi-dimensional content, including basic data (such as gender and place of origin of students), various dimensions of professional identity (professional will and expectation, professional value, professional effectiveness, professional identity), and the classification of events affecting professional identity (teacher behavior, teaching experience, learning process, family environment), etc. to explore the status of professional identity of normal university students and its influencing factors from multiple perspectives.

Normal university students from the college of primary education of Capital Normal University were sampled as the research objects, and 114 valid questionnaires were collected. The samples were representative and reliable, and could reflect the overall characteristics of normal university students in terms of vocational identity to some extent.

The questionnaire and interview outline were carefully designed in this study. The contents of the questionnaire covered multiple dimensions of professional identity, and the current situation was directly reflected through quantitative poetry. In addition, 9 normal university students were interviewed to understand their cognition, emotions, and values of the teaching profession, as well as the factors affecting professional identity, to provide strategic suggestions for improving professional identity and provide references for making

educational policies. The interview outline focuses on obtaining open and in-depth insights and understanding the psychological changes, challenges, and coping strategies of normal university students in the process of forming professional identity through face-to-face communication.

3. Summary and analysis of the research results

3.1. Basic data analysis

The number of female students (142) in the sample was significantly more than that of male students (35), accounting for 80.2% and 19.8% of the total number respectively (**Table 1**). Urban students (146) accounted for 82.5%, while rural students (31) accounted for 17.5%. Such distribution differences of gender and student origin may affect the subsequent analysis of occupational identity, and attention should be paid to the differences among different groups.

Table 1. Summary of participants' information

Group	Basic materials	Number of people	Percentage (%)
Gender	Male	35	19.8%
	Female	142	80.2%
Place of origin	Rural area	31	17.5%
	City	146	82.5%

3.2. Occupational identity dimension analysis

Although the mean and standard deviation caused by gender were different in the dimensions of occupational intention and expectation, occupational will, occupational value, occupational efficacy, and occupational identity, the *t*-test results of independent samples showed that the *t*-values did not reach significant levels ($P>0.05$). This indicates that in the samples of this study, gender has no significant impact on the dimensions of professional identity of normal university students, that is, there is no significant difference between male and female students in the overall level and each specific dimension of professional identity (**Table 2**).

Table 2. Data table of differences caused by gender factors

	Male (M ± SD)	Female (M ± SD)	t
Career aspirations and expectations	1.21 ± 0.39	1.20 ± 0.54	0.128
Occupational will	2.53 ± 0.78	2.70 ± 0.74	-1.217
Professional values	1.74 ± 0.63	1.77 ± 0.67	-0.277
Professional effectiveness	1.52 ± 0.49	1.62 ± 0.64	-0.930
Professional identity	1.75 ± 0.45	1.83 ± 0.52	-0.784

As for the difference in students' place of origin, the *t* value of urban students ($M = 1.23 \pm 0.55$) and rural students ($M = 1.08 \pm 0.21$) was 2.570 ($P<0.05$), which reached a significant difference (**Table 3**). This indicates that the vocational intention and expectation of urban normal students are significantly higher than that of rural normal students, which may be due to the abundant educational resources in urban areas and more access to

education-related information, etc., leading to their higher expectations of teaching careers. However, the *t*-value of vocational will, professional value, professional efficacy, and professional identity did not reach a significant level ($P>0.05$), indicating that the places of student origin had no significant influence on these dimensions, that is, urban and rural normal college students had similar levels of professional identity in these aspects.

Table 3. Data table of the differences caused by the factors of student origin

	Town (M ± SD)	Rural (M ± SD)	t
Career aspirations and expectations	1.23 ± 0.55	1.08 ± 0.21	2.570
Occupational will	2.68 ± 0.78	2.60 ± 0.75	0.561
Professional values	1.78 ± 0.68	1.70 ± 0.57	0.681
Professional effectiveness	1.61 ± 0.63	1.59 ± 0.51	0.216
Professional identity	1.83 ± 0.52	1.74 ± 0.41	0.837

The values of occupational willingness and expectation, occupational will, occupational value, occupational efficacy, and occupational identity are all in the range of 1.00 to 5.00 (the range of occupational identity is 1.00 to 4.67). The standard deviation corresponding to the mean values of each dimension shows that normal college students have obvious individual differences in these aspects. These data provide the key basic data and group characteristics reference for further exploring the relevant factors of the professional identity of normal college students.

Table 4. Data summary table

	Minimum	Maximum	M ± SD
Career wishes and expectations	1.00	5.00	1.20 ± 0.51
Occupational will	1.00	5.00	2.67 ± 0.75
Professional values	1.00	5.00	1.76 ± 0.70
Professional effectiveness	1.00	5.00	1.61 ± 0.61
Professional identity	1.00	4.67	1.81 ± 0.51

3.3. Analysis of events affecting occupational identity

The career identity of normal university students is affected by many factors, which can be divided into positive and negative factors (**Figure 1**).

The positive factors significantly encourage normal university students to form a positive professional identity. Teachers' solid professional skills, serious and responsible attitudes, and other behaviors set up professional models for students, and stimulate their yearning and identification of the teaching profession. In the teaching experience, the positive feedback of students and the teaching harvest of normal university students have enhanced the identity of normal university students in the teaching profession. Course learning consolidates professional identity, and extracurricular learning and self-cognition factors, such as learning about excellent teachers, also provide support for a positive professional identity. The family environment in which teachers are parents of normal university students also promotes the formation of professional identity.

The negative influencing factors bring challenges to the professional identity of teachers and students. Although the scores of the designed questionnaire are small, they reflect potential problems that may affect

the professional identity of normal college students, such as self-doubt caused by students not listening to the lecture in teaching experience, change of career idea caused by curriculum pressure in the learning process, and uncertain self-cognition of whether to engage in the profession of teachers, etc. (**Table 5**). In the process of education and teaching, attention and guidance should be paid.

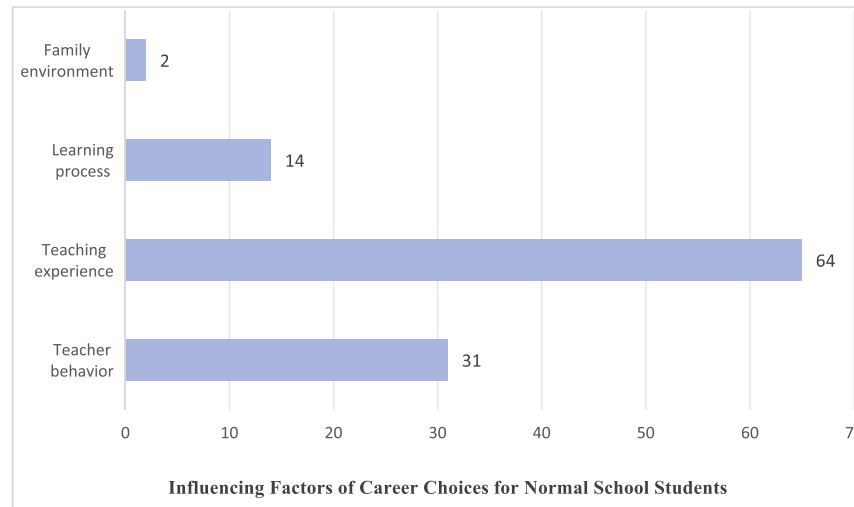


Figure 1. Influencing factors of career choices for normal school students

Table 5. Classification of events affecting the professional identity of normal university students (the numbers in the table below are 114 questionnaires)

Attitudes towards becoming a teacher	Influencing factors		Specific content summary
Positive (111)	Teacher behavior (31)	Qualities a teacher has	Solid professional skills, serious and responsible, with a sense of responsibility and mission, role model, love, and patience.
		The guiding role of teachers	Study life, conduct cultivation, psychological and emotional guidance.
	Teaching experience (64)	Feedback from students	The sense of achievement and happiness that come from feeling students’ needs and helping students to solve difficulties and make progress; Positive feedback from students in the classroom and recognition after class.
		Harvest methods and inspirations	Learn how to prepare and design lessons to attract students’ attention and improve classroom efficiency; Have a deep understanding of the important role of teachers, clear goals for future efforts, and firm faith in becoming a teacher.
	Learning process (14)	Course study	Learn professional knowledge and educational theories to deepen the understanding of education.
		Extracurricular life/self-knowledge	Learn about good teachers online and offline; Learning about students to motivate them towards their goals; And a conviction to become a teacher from an early age.
	Family Environment (2)		Parents are teachers and are deeply influenced by their parents’ educational ideas and methods.
Negative (3)	Teaching experience (1)		Students do not listen to the lecture and have self-doubt, reflect on the quality of the class and the teaching design, and question their suitability to become teachers.
	Learning Process (2)	Course study	Through education courses, I think that teaching is too stressful, and then I change my mind about becoming a teacher.
		Self-knowledge	I haven’t decided yet if I want to go into teaching.

4. Theoretical basis

As for the research on the status quo of professional identity of normal college students and its influencing factors, this study takes the “theoretical model of self-identity state” proposed by American psychologist James E. Marcia as the basic framework, which is also an important basis for analyzing professional identity of normal college students^[9].

Freud, the founder of the psychoanalytic school, first proposed the concept of identification, that is, individuals subconsciously imitate and internalize, and then make them psychologically consistent with others or groups. On this basis, Erikson further developed and proposed the theory of “self-identification.” Based on Erikson’s “self-identity” theory, Marcia proposed the “self-identity state theory model.” This model aims to describe the different states that adolescents experience in the process of exploring self-identity. Marcia proposed that self-identity contains two dimensions, namely “exploration” and “commitment.” Based on these two dimensions, Marcia further proposed four kinds of identity of individuals, namely, identity achievement, identity moratorium, identity foreclosure, and identity diffusion.

This study starts from the two core dimensions of the “theoretical model of self-identity.” “Exploration” refers to the process in which normal university students actively seek solutions to teachers’ career development problems, and then form a professional identity, covering the exploration of professional knowledge and skills, professional role quality, and self-cognition. “Commitment” is reflected in the belief that normal university students firmly devote themselves to the cause of education, and are willing to invest time and energy in it, such as actively participating in professional learning, full of enthusiasm and confidence in the cause of education, and making clear their own career planning.

Based on these two dimensions, the normal university students participating in the study can be divided into four categories. The normal university students in the status of identity acquisition show the characteristics of high exploration and high commitment, and they make a firm commitment after career exploration. In the state of identity delay, the students have a high exploration degree but lack commitment. The students with early closure of identity have made commitments without full exploration, showing low exploration and high investment. However, in the state of identity diffusion, the students lack exploration and make no investment, showing a state of low exploration and low investment. Therefore, the “self-identity state theoretical model” is of great significance in dividing the career identity stage of normal college students, analyzing the characteristics of the stage, and summarizing the influencing factors and mechanisms.

5. The specific interpretation of the identity state

5.1. Identity achievement

In Marcia’s self-identity theory, identity achievement represents a state of high exploration and high commitment. Normal university students have conducted an in-depth exploration of the teaching profession and made a firm commitment to devote themselves to their education career.

Such normal students usually have gone through the process of career exploration. They pay attention to the teaching profession at the beginning of their enrollment, actively participate in educational practice activities, clarify their career interests and goals, and closely link the teaching profession with their own development. They choose the normal major because of their love and understanding of education. They can match their own interests and advantages with the teaching profession, and have high enthusiasm in learning and practice, to continuously improve their professional quality and teaching ability.

At the stage of identity achievement, normal university students can flexibly use knowledge and constantly innovate teaching methods in practice, have clear plans and expectations for career development, and actively seek development opportunities. In the face of challenges and changes in the education industry, they can maintain a positive attitude, be good at reflection and summary, constantly adjust their teaching concepts and strategies, and often achieve better results and long-term development on the career path of teachers.

This state has a positive impact on the formation of normal university students' professional identity, which helps to establish firm professional belief and commitment, promote their in-depth exploration of the connotation and requirements of the teacher profession, improve professional quality and teaching ability, form a positive self-professional identity, and lay a solid foundation for career development.

5.2. Identity moratorium

Identity moratorium is a state of high exploration and low commitment, which means that normal university students have launched a certain exploration of the teaching profession, but have not formed a firm career will and expectation, and their professional identity is relatively low.

The concrete manifestation is the wait-and-see attitude towards the teaching profession, the choice of primary education major partly due to the score limitation, the lack of love for the teaching profession, and the confused career direction. This kind of choice based on scores rather than interest makes them hesitate in the face of the teaching profession. Studies have also shown that students who choose to major in teacher education because of external factors rather than their own interests are more likely to have a wait-and-see attitude toward teaching ^[10]. At the same time, according to the survey, normal university students in the identity moratorium state are significantly lower than students in other states in enthusiasm for participating in educational practice ^[11]. Their resistance to practical activities makes it difficult for them to deepen their understanding and identification of the teaching profession in practice. In addition, such students generally lack a clear career plan. It is found in the interview that although some normal students choose to major in teacher education, they only have vague ideas about their future career planning, and their specific plans are not clear. Some studies have pointed out that the vagueness of career planning will affect the degree of normal students' investment in teaching careers and reduce their professional identity ^[12].

In conclusion, the reasons leading to the status of identity moratorium of normal university students include individual, family, school, and society. At the individual level, when the fit between themselves and the profession is not clear, it is difficult for them to fully devote themselves to the exploration of the teaching profession, and thus it is difficult to form a firm career commitment ^[13]. In terms of family factors, parents' and children's differences in understanding and expectations of the teaching profession, as well as parents' over-protection, lead to children's lack of independent exploration and decision-making ability. Studies have shown that normal university students with a high degree of family support have a higher degree of professional identity and exploration enthusiasm ^[14]. There are some deficiencies in school education, such as the curriculum of some normal colleges, which is highly theoretical and out of touch with practice, the teaching methods of teachers are single, and the guidance of students' career interests and identity is lacking ^[15]. Society's negative evaluation of the teaching profession, such as high work pressure and unsatisfactory salary, also reduces the enthusiasm of normal university students to explore and produces a fear of difficulties ^[16].

It can be seen that normal university students in the identity moratorium state lack motivation and goals in learning and practice, and are easy to be disturbed by the outside world. On the other hand, teachers with

low professional identity are more likely to suffer from job burnout, and their involvement and enthusiasm in teaching work are also lower ^[17]. However, they are still actively exploring, with active thinking and an open mind to different educational concepts and teaching methods, and the accumulated experience and knowledge will help them better understand and adapt to the teaching profession in the future ^[18].

This is a common state in the formation of normal university students' professional identity, and teachers and educational institutions should give more guidance and support.

5.3. Identity foreclosure

Identity foreclosure means that an individual makes a commitment to a certain profession without full exploration. For normal university students, this state is embodied in making a commitment to the teaching profession without full exploration.

The status of identity foreclosure of normal university students is often the result of the joint action of society, family, and individual. In the country, society gives high status to primary and secondary school teachers, and some normal college students will be affected by the characteristics of teachers' work such as social status, and then choose to engage in the teaching profession. In addition, social and cultural stereotypes and traditional concepts of the teaching profession also lead to the early closure of the identity of normal college students to a certain extent. For example, society may regard teaching as the ideal career for women, so some female normal students choose the teaching profession under the influence of others to fully explore the practical suitability of the teaching profession with themselves ^[19]. Based on these social factors, some parents and family members of normal college students expect teachers to be engaged in the profession because of the stability and security of the profession, but normal college students accept this concept without full consideration, putting themselves in a state of identity foreclosure.

The concrete manifestation is that their understanding of the teaching profession only stays on the surface, they rarely participate in career exploration activities, and they are prone to self-doubt when they get in touch with the work of teachers, and they cannot persist in the teaching profession for a long time. At the same time, although the normal university students in this state choose the teacher major and complete the corresponding learning tasks, they do not carry out corresponding exploration, and they are still uncertain about whether to engage in the teaching profession in the future. In addition, due to the influence of family or society, normal college students in the state of identity foreclosure do not choose the profession completely voluntarily, so their learning motivation and learning commitment are lower than those who have fully explored and made commitments ^[20].

Identity foreclosure has many effects on the formation of the professional identity of normal university students. The positive effects include that there is a clear career direction in the short term, which is conducive to focusing on early teacher professional learning, and the stability of the early vocational identity is high. However, in this state, normal university students lack the process of self-exploration, the identity of teacher occupation only stays on the surface, and it is difficult to adapt to the diversified development trend of education.

5.4. Identity diffusion

Identity diffusion is a state of low exploration and low commitment. For normal university students, neither fully explore the teaching profession, nor firmly establish the will and expectation to join the profession.

The state of identity diffusion is the result of internal factors and external environment. In terms of personal internal factors, some normal university students have unclear self-cognition, and it is difficult to connect the teaching profession closely with their own development. In the interview, many normal university students said that their choice of teacher education major was due to external factors such as scores and employment stability, but not due to their love for education. In terms of the external environment, the negative evaluation of the teaching profession by society, such as high work pressure, unsatisfactory salary, and difficulty in dealing with conflicts between family and school, reduces the enthusiasm of normal university students to explore^[21]. At the same time, some schools lack vocational education, vocational planning courses are not targeted, and practical activities are not arranged properly, which cannot effectively guide normal students to have a deep understanding of the teaching profession^[22].

In the interview, the feedback of some normal college students reflects the characteristics of identity diffusion. Some normal university students mentioned that the choice of primary education major is mainly due to the score factor, and they did not have much in-depth thinking about the future teaching industry, and their cognition of the teaching profession only stayed on the surface, and they were not clear about the future career plan. In addition, interviews with some normal university students also found that such students lack the willingness to participate in educational practice and practical activities, and do not actively experience the actual work scenes of the teaching profession, which makes it difficult to deepen the understanding and identification of the teaching profession in practice, reflecting the lack of exploration.

This kind of state is not conducive to the development of normal college students. Due to the lack of professional enthusiasm and awareness of active exploration, they lack the motivation to learn professional knowledge. In future employment, they may be prone to frequent career changes due to their low professional identity, which is not conducive to the stability of the teaching team^[23].

Promotion measures: Schools and families should provide more vocational enlightenment and guidance to promote normal university students in the state of identity diffusion to form a positive teacher professional identity. Schools can add career planning courses and organize various educational practice activities to make normal students feel the charm of the teaching profession; Families should provide support and encouragement to create a positive atmosphere for career exploration^[24].

6. Conclusion

This study delves deeply into the current status and influencing factors of professional identity among normal students majoring in primary education analyzes four identity states of professional identity of normal college students in combination with the theoretical model of self-identity, and reveals the specific manifestations and reasons under different states. Without further improving the professional identity of normal college students, future education needs to start from the three aspects of individuals, educational institutions, and society, and take measures to optimize the education curriculum, strengthen career guidance, improve the social environment, and so on to enhance the professional commitment and professional behavior of normal college students. Future research will further explore the differences of vocational identity of normal college students in different education stages and different regions, and how to effectively improve their vocational identity through specific intervention measures.

Disclosure statement

The authors declare no conflict of interest.

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Research and Implementation of Blended Teaching Mode under the Background of Artificial Intelligence—A Case Study of Business Educational Courses

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Abstract: Higher education is always about reforming the teaching method because of the deep integration of artificial intelligence and education, which is becoming an unavoidable trend. Taking business educational courses for example, this paper constructed a blended teaching mode in the teaching and learning process, which was proved to be more efficient for teachers and students. By applying the blended teaching model, teachers can improve teaching quality by strengthening cognition, optimizing methods, engaging in multifaceted practice, and optimizing platforms.

Keywords: Blended teaching mode; Artificial intelligence; Business educational courses

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1. Introduction

As people enter the era of artificial intelligence, the core technologies of the Internet and AI have reached a new level of maturity, making traditional teaching methods like rote learning and cramming insufficient to meet the needs of today's students. Numerous areas, including finance, healthcare, education, and manufacturing, are seeing tremendous progress thanks to the rapid development of core artificial intelligence technologies. In the long run, the impact of artificial intelligence technology should prioritize practical application over mere gimmicks. The advancement of smart education brings forth both prospects and difficulties. For company education, the innovation and design of teaching mode, teaching method, and teaching process have deep connotations. The School of Economics at Guangzhou City University of Technology has been continuously exploring and implementing blended teaching reforms in business courses, incorporating cutting-edge artificial intelligence technologies, and has achieved numerous accomplishments^[1].

2. Background of the artificial intelligence era

Artificial intelligence technologies encompass machine learning, expert systems, knowledge graphs, random search algorithms, artificial neural networks, and more, as shown in **Figure 1**. The rapid development of artificial intelligence takes technical innovation as the entry point, meets various educational topics and teaching links, and continuously promotes the innovation of teaching products, process optimization, and the improvement of teaching efficiency. In recent years, artificial intelligence products such as smart speakers, AlphaGo robots, ChatGPT, etc. have surfaced continuously. The “New Generation Artificial Intelligence Development Plan”, released by the State Council, delineates China’s goals for AI development by 2030, with a focus on speeding up the creation of an innovative and globally leading technological powerhouse, while emphasizing the interconnected growth of research and development, product application, and industry cultivation, while insisting on the integrated development of research and development, product application, and industry cultivation ^[2].

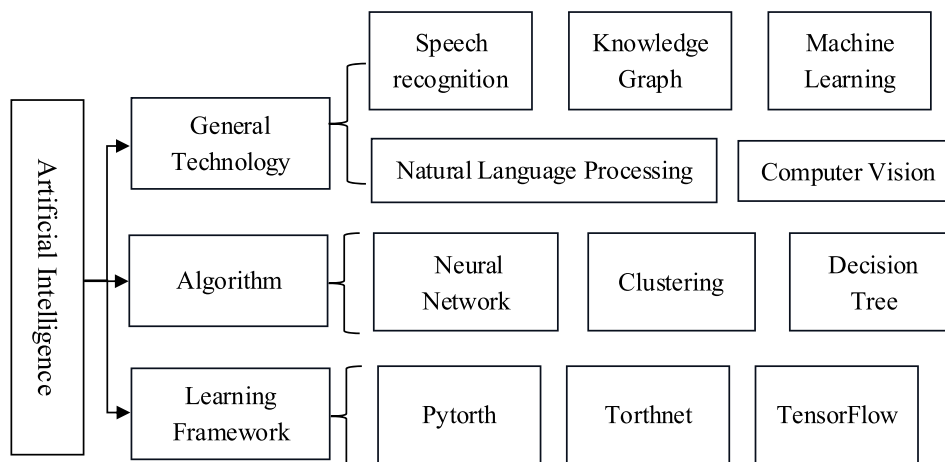


Figure 1. Core artificial intelligence technologies

In the era of artificial intelligence, teaching will become more intelligent. The upgrading of artificial intelligence tools promotes further reforms and explorations of teaching modes by educational practitioners. Technological updates and iterations can diversify and personalize students’ learning processes. This will not only change students’ learning methods but also provide teachers with more opportunities. Since the continuous improvement and development of business education courses, the degree of specialization is high, the connection with the social scene is close, the content is rigorous and serious, and the knowledge is broad. However, in the new era, how to enable the development dividend of artificial intelligence technology to business education has become a difficult problem. While teaching business-related knowledge, teachers also assist students in establishing the correct ethical values in finance. The exploration of blended teaching modes in the context of artificial intelligence has gradually become one of the focuses of educational practitioners.

3. Characteristics of business education courses

Business education courses integrate foundational theories from disciplines such as economics, finance, and investment, covering content related to mathematics, operations research, and systems science. Business education courses not only incorporate modern finance, information technology, and engineering methods but

also play a crucial role in fields such as economic management. The construction goal of a business education curriculum is not only to make students have a solid financial, mathematical, computer knowledge and foreign language level, but more importantly, to promote students to establish a strong sense of innovation, help students broaden their horizons at the spiritual level, and improve their ability to solve problems. Through the study of business education courses, students can basically master the basic principles of economics and the main concepts and theoretical knowledge of financial engineering, finance, international business, etc., and have the ability to apply financial engineering, mathematics, computer knowledge, and at the same time apply this knowledge and ability to practice.

With the rapid development of Internet technology, business education courses continue to differentiate, and the teaching content gradually tends to be combined with financial technology. Courses such as artificial intelligence, cloud computing, financial frontier topics, and financial technology have emerged one after another. From the perspective of talent training, financial engineering courses are facing new changes, being familiar with computer programming and AI technology, and the ability to apply scientific and technological means to financial practice are gradually listed as teaching and training objectives. Every year, there is an endless stream of high-efficiency graduates majoring in business. To better adapt to the demand of the job market, business education is transforming to information education, and the teaching model needs to be changed accordingly to better adapt to the present. Application of the blended teaching model under the background of artificial Intelligence has become a focal point of current research in the near future.

Guangzhou City University of Technology has five typical majors of Business education: financial engineering, economics, international economics and trade, economic statistics and taxation. The school takes advantage of the blended teaching model by providing a large quantity teaching resources, high-quality teaching ideas, improving the students' subjective initiative, and stimulating students' interest. In addition, the students have won many international and national academic competition awards, such as the international first prize in the 2018 American Mathematical Contest in Modeling for College Students (MCM/ICM), and the Silver Prize in the "Internet +" Innovation and Entrepreneurship Competition for College Students in Guangdong Province in 2021 under the guidance of the teachers. Covering universities across the country, the event is the largest comprehensive event in China and one of the most influential events. From the perspectives of artificial intelligence, blockchain, cloud computing, and big data, the school of economics conducts in-depth analysis, exploration, and handling of economic issues, leading students to seize opportunities, win the initiative, and integrate into the development trend of the national and world economy.

4. Deficiencies of the traditional teaching model

Business courses cover required courses and elective courses, such as economics, introduction to financial engineering, introduction to fintech, corporate finance, investment theory, international finance, financial derivatives, etc. The traditional teaching model emphasizes the process of teacher instruction, with the teacher as the center, and the teaching resources are single, which can be divided into three stages: teaching, learning, and feedback. The teaching models mainly focus on the one-way transmission of knowledge^[3]. Some classes also include case analysis, classroom discussions, and assignments, but the teaching activities are relatively dull. The deficiencies of the traditional teaching model are obvious.

4.1. One-way output by the teacher

Under the traditional teaching model, teachers mainly rely on textbooks and assistive multimedia equipment for one-way output. On the one hand, they can have complete control over the content and scope of the textbook, but on the other hand, the implementation of the course is inflexible. It is difficult for teachers to tailor their teaching to individual students, and they generally have uniform requirements and standards for students, lacking the ability to discern students' learning outcomes. In traditional teaching, teachers themselves think in a fixed way, seldom communicate with students, pay little attention to students' concentration and expression ability, and it is difficult to improve students' practical operation ability, and basically can only stay at the level of textbook knowledge. The dominant position of the teacher determines the tone of the classroom, often causing students to lose interest and find the classroom content boring, leading to a situation where they give up learning. The classroom atmosphere mostly depends on the teacher's personality, and what attracts students is mostly the teacher's teaching style rather than the depth and breadth of their professional knowledge. Teachers themselves have very limited resources, and it is difficult for them to obtain more data or case materials from financial institutions or companies. Some teachers stick to the script and have little updates in their classroom design, lack of learning resources, and lack of motivation.

4.2. Strong passivity of students

Students are also important participants in the teaching process and one of the determinants of classroom efficiency. Traditional classrooms have low requirements for students, and students themselves have a strong sense of passivity, relying on the teacher's thinking patterns, and their self-growth is slow. In the process of learning course knowledge, it is difficult for students to improve their innovative ability, understanding ability, and problem-solving ability. Moreover, in the traditional teaching mode, students rarely refute teachers' views and are basically in a situation of full acceptance, and it is difficult for teachers to cultivate students' divergent thinking, which makes some students' questions about professional knowledge after class basically limited to textbook knowledge, and students' ability to combine textbook knowledge with practical application is poor. In class, most students deal with the classroom teacher's questions, do not preview before class, do not review after class, and lack subjective initiative. The communication between students and teachers, and the direct communication between students and students is even less.

4.3. Lack of evaluation feedback and process-based assessment

In traditional classrooms, students have little feedback on the content of the class, mainly concentrated on the process of questioning during or after class. Students evaluate the courses at the end of each semester, but overall, very few students can provide teaching suggestions and evaluation feedback during the semester. Secondly, under the traditional teaching mode, teachers' teaching and students' learning are combined. When the course content is designed theoretically and specialized knowledge points, it is difficult for students to understand, and the process assessment process in the classroom is less. The teaching process is controlled by teachers, who often ignore students' classroom experience for the sake of teaching progress, which makes it difficult to teach students according to their aptitude and ensure the learning effect.

5. Advantages of the blended teaching model

The blended teaching model can be understood as a combination of traditional teaching and online

teaching^[4]. Based on traditional teaching, technology update and digital resource advantages, blended teaching improves teaching quality and promotes teaching reform through mutual assistance of physical teaching and physical classroom. The advantages of implementing blended teaching include the following three points.

5.1. Diversified resources and diverse learning methods

Small Private Online Course (SPOC) platforms based on artificial intelligence can assist teachers in building online resources. As the Massive Open Online Courses (MOOC) online learning is not suitable for all students from different schools, teachers are encouraged to build up their own online courses. SPOC is a newly emerged educational model. The blended teaching model of SPOC with the specialized courses teaching has become a new exploring point.

Students can spontaneously engage in online learning and participate in offline discussions, which is very suitable for implementing flipped classrooms. For example, most financial engineering courses have dispersed knowledge points and abstract theories. Through courses using Python, Stata, etc., students' hands-on ability can be developed and their logical thinking can be expanded. By adding online programming software practice courses to theoretical teaching, students can effectively acquire more skills and adapt to employment demands. Guangzhou City University of Technology has established online course systems for financial engineering, corporate finance, and Chinese tax law at the school level, focusing on students and output-oriented, continuously improving the teaching model.

5.2. Flexible course design with clear course objectives

In blended teaching, teachers need to redesign courses, allocate time for pre-class, in-class, and post-class activities, and make use of resources from platforms such as online classrooms and learning portals. They establish new teaching steps and teaching plans, and emphasize the "student-centered" curriculum objectives, aiming at cultivating virtue and nurturing talents. They set learning and assessment schemes tailored to differentiated and personalized students, and enrich teaching content through methods such as exercises, discussions, voting, case analysis, and online exams. This aims to achieve the goals of moral education, innovation, and enhancing students' problem-solving abilities.

5.3. Innovative assessment methods and enhancement of process-based assessment content

Under blended teaching, teachers need to update the assessment plan, collect online learning records such as students' self-study, discussion, attendance, and homework by using the platform, analyze and use the data, increase the proportion of normal grades, and then make a reasonable evaluation based on the offline exam scores at the end of the semester. This not only emphasizes students' independent learning, enhances students' learning initiative, further increases the proportion of process assessment, and helps teachers to continuously improve the teaching process and improve the teaching quality. The courses of finance majors are closely connected with the real world. Online platforms can be used to assign social research tasks in groups to help students better understand professional knowledge and enhance their understanding of society.

6. Implementation steps of the blended teaching model

Blended teaching has become a new norm, and it should effectively organize offline and online spaces and

resources. It is not simply about transferring offline textbook content to the online platform and repeating the teaching process. The implementation steps of the blended teaching model can be categorized into three stages: pre-class, in-class, and post-class activities.

6.1. Pre-class preparation stage

During the pre-class stage, teachers can utilize online resources to assist students in completing pre-class preparation. The duration of course learning is not limited to in-class hours, and management should also extend to out-of-class hours. Overall, it is important to emphasize the alignment of form and content, select appropriate teaching methods, focus on concepts and applications, and stimulate students' interest in learning. Teachers can introduce introductory videos or diagnostic tests before class, utilize AI-assisted self-learning, and help students familiarize themselves with the key points, difficulties, and learning framework.

6.2. In-class implementation stage

In the implementation stage of the class, teachers can not only give PPT lectures in class but also use online mode to arrange for students to independently learn various case analysis, exercise explanations, and other resources. Students can utilize the platform to ask questions, and teachers can provide timely feedback. The content of both online and offline teaching should not be mere repetition, but rather complementary, with challenging and novel knowledge points. Additionally, teachers should establish a quality baseline to ensure that students meet the minimum requirements, and also provide resources that go beyond expectations.

6.3. Post-class consolidation stage

During the post-class consolidation stage, teachers should track and provide feedback. Teachers can arrange learning activities, ensure a moderate workload for students, and assign post-class assignments, group discussions, group projects, etc., to support student interaction and engagement, emphasizing active learning and the development of higher-order skills ^[5].

In the overall assessment process, evaluation methods are gradually becoming more diversified and have reasonable assessment criteria, providing a basis for teachers to track students' learning progress. Particularly in offline assessments, attendance should not be included in the grading and should only serve as a record of student participation in class. In online assessments, assignments, reports, and tests are submitted in online formats and assessed through online feedback. Collecting data through information technology helps evaluate students' overall learning outcomes. Online learning duration and records should only be used as reference points in the assessment process and should not be directly considered as assessment criteria.

7. Strategies to strengthen the blended teaching model

In the ever-changing era, "Transformation: A Mindset for Coping with the Complex New World" presents the Malik curve, which highlights the transition between the old and new eras. In the current impact of digital education, transformational change will gradually lead to mediocrity or even disappear if it is not timely. To construct the Malik curve of education, we should do the following four aspects.

7.1. Strengthening cognition

Firstly, in teaching, teachers should reach a consensus on the development of artificial intelligence technology

and the expansion of intelligent education, actively adapting to technological changes. Outdated teaching concepts cannot keep up with the development of the times. Focusing on the goal of improving students' abilities, positioning the ability system, revising the curriculum outline based on the Outcome-Based Education (OBE) concept, and improving the evaluation system for achieving course objectives. The new three centers focus on students, learning, and learning outcomes, shifting the emphasis from traditional teaching, textbooks, and classrooms. The use of blended teaching models provides a better path for innovative teaching reforms, allowing for the inclusion of each teacher's creative thinking, serving teacher development, promoting the deep integration of information technology and teaching, and further enhancing the quality and effectiveness of teaching.

7.2. Optimizing methods

In the context of intelligent education, teachers can leverage knowledge graphs to support teaching reforms and update teaching models, innovating curriculum design methods and strategies. A knowledge graph is a visualization technology that describes knowledge resources and carriers, and enables in-depth exploration, analysis, construction, visualization, and display of knowledge, as shown in **Figure 2**. By extracting knowledge and forming various knowledge relationships, an electronic teaching resource and practice platform can be built to serve student development. Students can flexibly arrange learning content, allocate learning priorities and challenges, expand learning time and space, and have high flexibility and strong personalization. Establishing knowledge point-level online learning using knowledge graphs, tracking students' learning progress through video learning traces, and enabling efficient intelligent retrieval are the trends in online learning development. In this process, key learning points refer to the core concepts and knowledge points that students need to focus on and understand to better grasp and apply what they have learned.



Figure 2. Core technologies of knowledge graph

7.3. Multifaceted practice

Utilizing AI recommendation systems, personalized guidance can be provided to students for offline self-directed learning, completing assignments, and reinforcing knowledge. Updating the teaching syllabus and estimating the time burden of online and offline learning, with a focus on outcome-oriented results, clarifies

the abilities that students can acquire. Insufficient offline time fails to reflect the innovativeness and challenges of the course. Teachers should strive to increase interactive learning by incorporating practice-based teaching, student-led presentations and evaluations, peer assessments, debates, and discussions, as well as expanding learning channels through various resources such as textbooks, course materials, videos, exercises, and discussions. For example, in a Python course, one-third of the class time can be dedicated to whole-class lectures, one-third to in-class exercises, and one-third to in-class experiments, followed by assessments based on different categories (**Table 1**).

Table 1. Hybrid teaching design for Python

	Lecturing	In-class exercises	In-class experiments
Allocation of class hours	One-third of the total class hours	One-third of the total class hours	One-third of the total class hours
Assessment methods	Written examination	Submit assignments	Submit experimental reports
Teaching methods	Face-to-face teaching	Online self-directed learning	Complete in groups of 5-6 members

7.4. Optimizing platforms

By constructing an AI course resource platform, teachers can address the pain points and challenges of the course and enable both online and offline, in-class and out-of-class, and theoretical and practical teaching. Teachers can compile course resource indexes, recommend resources, cater to small class sizes, ensure rapid updates, and offer high levels of challenge. Implementing a game-based learning approach, intelligent question-and-answer systems, and setting up different difficulty levels can stimulate students' interest in learning. The power of the teaching platform is significant, as it possesses a unified data foundation, a cloud-based data platform, and a governance system for transformative change. The development of online course resources is an ongoing and continuous accumulation process without an endpoint. The construction serves as the foundation, while the application is the key, effectively harnessing the application benefits of course development in serving talent cultivation.

8. Summary

The use of technologies for higher education reforms is not new. The deep integration of artificial intelligence and education has become an inevitable trend, and the reform of the teaching mode is a permanent subject for higher education. By applying the blended teaching model, teachers can improve teaching quality by strengthening cognition, optimizing methods, engaging in multifaceted practice, and optimizing platforms. In the future, artificial intelligence technology will develop rapidly, offering the possibility for teachers to improve teaching methods, reform course assessments, and enhance efficiency. This certainly presents an impressive challenge.

Disclosure statement

The authors declare no conflict of interest.

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Exploration of the Quality Assurance System in Universities under the New Round of Education and Teaching Audit Evaluation

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Abstract: As China's higher education enters the stage of universal access, improving the quality of education and teaching has become the core task of university development. The new round of education and teaching audit evaluation, as the starting point of classified evaluation of higher education in the new era, is of great significance for promoting the high-quality development of higher education and improving the internal quality assurance system of universities. This paper focuses on the new round of education and teaching audit evaluation and deeply explores the construction of the quality assurance system in universities. It expounds on the significance of the evaluation for university development, analyzes the existing problems in the quality assurance systems of private universities, and proposes strategies for constructing and improving the quality assurance system from aspects such as reform ideas, characteristic innovation, and specific practices. The aim is to promote universities to achieve high-quality connotative development, improve the quality of undergraduate education and teaching, and cultivate high-quality talents with all-around development.

Keywords: The new round of audit evaluation; University quality assurance system; Private universities; Quality of education and teaching

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1. Introduction

Private universities have played an important role in the process of popularizing higher education in China. However, with the expansion of scale, many problems have emerged in their quality assurance systems, restricting their connotative development^[1]. The "Implementation Plan for the Audit Evaluation of Undergraduate Education and Teaching in Regular Institutions of Higher Education (2021–2025)" issued by the Ministry of Education points out the direction for the construction of the quality assurance system in universities. In this context, studying how to construct a scientific and effective quality assurance system in universities under the new round of audit evaluation is urgent and of practical significance for private

universities and even the entire field of higher education ^[2].

2. The significance of the new round of education and teaching audit evaluation

2.1. Guiding the classified evaluation of higher education

Against the backdrop of the diversified development of higher education, different types of universities have different school-running orientations and development goals. The new round of audit evaluation formulates differential evaluation indicators and standards according to the characteristics of different types of universities, guiding universities to clarify their own positions and develop their unique features ^[3]. For example, for application-oriented universities, the evaluation pays more attention to the depth of cooperation with industries and enterprises, the effectiveness of practical teaching, and the quality of graduates' employment. For research-oriented universities, it focus on the feedback of scientific research achievements transformation on teaching and the support of academic innovation ability for talent cultivation. This classified evaluation model helps universities find their development directions, avoid homogeneous competition, and achieve differential and characteristic development.

2.2. Promoting the high-quality development of higher education

Higher education in the stage of universal access should not only pursue scale expansion but also pay more attention to quality improvement. The new round of audit evaluation takes the effectiveness of cultivating people with morality as the fundamental standard and focuses on the key links of undergraduate education and teaching quality, such as the scientific nature of talent training programs, the rationality of the curriculum system, and the effectiveness of teaching methods ^[4]. Through the evaluation, universities are urged to strengthen connotative construction, optimize the allocation of education and teaching resources, improve the quality of talent cultivation, and promote the transformation of higher education from scale development to quality improvement, achieving the goal of high-quality development.

2.3. Improving the internal quality assurance system of universities

Constructing a sound internal quality assurance system is the key to the sustainable development of universities. The new round of audit evaluation requires universities to establish a quality culture of self-awareness, self-reflection, self-discipline, self-inspection, and self-correction, and improve the operation mechanism of the internal quality assurance system ^[5]. This helps universities clarify the responsibilities of various departments in quality assurance, strengthen the monitoring and management of the teaching process, timely discover and solve problems in education and teaching, form a long-term mechanism for continuous improvement, and continuously improve the overall school-running level of the university.

3. Problems in the quality assurance systems of private universities

3.1. Lagging quality culture construction

The concept of quality culture in private universities has not been fully established, and the construction of quality culture lacks systematic planning. On the one hand, the carriers of quality culture construction are relatively single, mostly limited to traditional teaching inspections, evaluations, and other activities, lacking innovation and attraction. On the other hand, the quality cultural atmosphere is not strong enough. The sense

of identity and participation of faculty and staff in quality culture is not high, and the corresponding supporting measures and operation mechanisms are not perfect ^[6]. As a result, quality culture cannot be integrated into the whole process of quality assurance, leading to a lack of cultural support for quality assurance work and making it difficult to form a long-term driving force.

3.2. Backward teaching concepts and methods of teachers

Some teachers have an insufficient understanding of the outcome-based education (OBE) teaching concept and have not truly integrated the education concept of “student-centered” into teaching practice ^[7]. In the selection and update of teaching content, they do not closely combine the needs of economic and social development and talent training goals. The teaching content is outdated and divorced from reality. At the same time, some teachers’ teaching methods are old-fashioned. They are accustomed to traditional lecture-based teaching and cannot master and apply new teaching methods such as seminar-style, flipped classroom, and blended learning. In addition, in the teaching process, they are not proficient in using new teaching software, which affects the improvement of teaching effects and teaching quality.

3.3. Unclear responsibilities of “management, operation, and evaluation”

The unclear division of responsibilities among “management, operation, and evaluation” is a common problem in private universities. The boundaries among school management departments, teaching implementation departments, and teaching evaluation departments are blurred, and their functions overlap ^[8]. Management departments are responsible for both teaching management and teaching evaluation. Teaching implementation departments lack autonomy in the teaching process and have to deal with multiple evaluations from different departments, resulting in low teaching management efficiency. The objectivity and fairness of teaching evaluation are affected, and the respective functions of “management, operation, and evaluation” cannot be effectively exerted, restricting the effective operation of the quality assurance system.

3.4. Single quality monitoring and evaluation methods

At present, the quality assurance monitoring and evaluation methods in private universities are relatively single, mainly relying on traditional means such as teaching inspections and student evaluations of teaching. The promotion and application of information-based monitoring and evaluation methods are insufficient. Modern information technology such as the Internet, big data, and artificial intelligence have not been fully utilized to conduct comprehensive and real-time monitoring and analysis of the teaching process and teaching effects ^[9]. The scope of teaching quality monitoring is relatively narrow, often focusing on the classroom teaching link, and the monitoring of practical teaching, curriculum construction, and students’ learning processes is not comprehensive enough. It is difficult to accurately grasp the overall situation of education and teaching quality, and it cannot provide strong data support for quality improvement.

3.5. Imperfect incentive and restraint mechanisms

In the quality assurance systems of private universities, the incentive and restraint mechanisms need to be improved. In terms of continuous improvement, there are no effective incentive measures for teachers and departments that actively participate in the improvement of teaching quality, making it difficult to fully mobilize their enthusiasm and initiative ^[10]. At the same time, the accountability for the main bodies responsible for

teaching quality problems is not strong enough. There is a lack of a clear accountability system and effective restraint mechanisms, resulting in some responsible units paying insufficient attention to teaching quality problems and delaying the implementation of rectification, affecting the overall improvement of teaching quality.

4. Practical paths for the quality assurance system in universities under the new round of education and teaching audit evaluation

4.1. Reform from a hierarchical mechanism to a cultural mechanism to promote the in-depth penetration of quality culture among teachers and students

Under the background of the new round of education and teaching audit evaluation, universities should take “cultivating people with morality” as the core mission of education. This is not only a return to the essence of education but also an inevitable requirement for cultivating comprehensively developed talents^[11]. “Cultivating people with morality” should run through all aspects of school work and become the fundamental criterion for measuring the effectiveness of various school work. To this end, first of all, it is necessary to break the “five-only” ideology and change educational concepts. The “five-only”, namely “only focusing on scores, only focusing on college entrance examinations, only focusing on diplomas, only focusing on papers, and only focusing on academic titles”, is an outdated concept that seriously restricts the development of education and hinders the all-around growth of students. Universities should attach great importance to the construction of curriculum-based ideological and political education and deeply explore the ideological and political education elements in various courses^[12]. For example, in science and engineering courses, students’ patriotism and innovative spirit can be cultivated by telling the stories of scientists. In humanities and social science courses, students can be guided to establish correct values and a sense of social responsibility. In this way, curriculum-based ideological and political education and ideological and political courses can work in the same direction and form a collaborative education effect. In addition, the construction of teachers’ professional ethics is an important link in promoting the in-depth penetration of quality culture among teachers and students^[13]. Universities should establish and improve the assessment mechanism for teachers’ professional ethics and include teachers’ professional ethics performance in key links such as teacher performance assessment and professional title evaluation. Through clear assessment standards and strict assessment processes, teachers are encouraged to consciously establish a good image of professional ethics. In the assessment process, not only should attention be paid to teachers’ teaching achievements, but also their moral performance in the teaching process, such as whether they care about students and whether they are rigorous in academic research. At the same time, universities should formulate human-oriented systems and ensure their effective implementation. In the work of quality monitoring and evaluation, the actual situations of teachers and students should be fully considered to avoid one-size-fits-all evaluation methods. For example, for teachers with relatively poor teaching conditions, more support and help should be given instead of simply criticizing and blaming. Only by being fair and just can ensuring teaching quality become the conscious behavior of every faculty and staff member, thus creating a strong quality culture atmosphere.

4.2. Implement the OBE teaching concept and establish and improve the teaching quality assurance system

The Outcome-Based Education (OBE) teaching concept emphasizes taking students’ learning outcomes as the

starting and ending points. Under the new round of audit evaluation, universities should highlight this concept and consolidate the key points of school-running, that is, “taking undergraduate education as the foundation and taking students as the center.” In the construction of the teaching quality assurance system, it is crucial to pay attention to the closed-loop of the system. The system should cover “all staff, the whole process, and all aspects”, requiring universities to include everyone from leading cadres to grassroots teachers, from enrollment to graduation and employment, and from classroom teaching to extracurricular practice in the teaching quality assurance system. A complete and regular internal education and teaching quality assurance operation mechanism should be established, and the “PDCA” (Plan, Do, Check, Act) model should be effectively implemented ^[14]. First, in the planning stage, universities should formulate scientific and reasonable teaching plans according to their school-running orientation and talent training goals. Second, in the implementation stage, ensure that the teaching plans can be effectively implemented. Then, in the inspection stage, the teaching process and teaching effects are inspected and evaluated through various methods. Finally, in the treatment stage, teaching strategies and methods are adjusted in a timely manner according to the inspection results. In addition, universities should use evaluation and certification to promote self-inspection, self-correction, and the improvement of connotative quality. On the one hand, through internal evaluation, universities can timely discover problems in the teaching process, such as unreasonable curriculum settings and single teaching methods, and make rectifications. On the other hand, through external evaluation, universities can learn from the advanced experience of other universities and continuously improve their own teaching quality assurance systems. For example, by participating in industry-wide evaluation and certification activities, universities can learn the successful practices of similar excellent universities in professional construction, curriculum reform, and other aspects, and apply and innovate based on the actual situation of their own schools.

4.3. Cultivate the teaching supervision team in universities to improve the level of teaching quality supervision

The separation of “management, operation, and evaluation” institutions is an important measure to improve the efficiency of teaching quality supervision. Universities should clarify the division of responsibilities among management departments, teaching departments, and evaluation departments to avoid overlapping functions ^[15]. Management departments are responsible for formulating teaching policies and plans, teaching departments focus on teaching implementation, and evaluation departments independently carry out teaching quality evaluation work. In the specific implementation, first, the supervision and follow-up mechanism for teaching quality problems should be improved to ensure that teaching quality problems can be dealt with in a timely manner. When teaching quality problems are discovered, the supervision and follow-up mechanism should be activated promptly, the responsible subjects should be identified, the rectification time should be limited, and the rectification process should be tracked and supervised. Strengthening the training of teachers’ teaching skills is the key to improving teaching quality. Universities can regularly organize teachers to participate in teaching skills training activities, invite education experts to give lectures and provide guidance, and improve teachers’ teaching design and classroom management abilities. At the same time, curriculum content construction should be strengthened, and the curriculum system should be optimized. The curriculum content should be updated in a timely manner according to industry development and social needs to improve the practicality and pertinence of the curriculum. In addition, supervision and inspection should be carried out through internal-external cooperation to introduce advanced teaching concepts and methods from outside. Universities can invite external

experts to participate in teaching supervision work. These experts have rich teaching experience and cutting-edge educational concepts, and their opinions and suggestions can provide new ideas for the school's teaching reform. For example, inviting enterprise experts to participate in the supervision of practical courses, and according to the actual needs of enterprises, putting forward improvement suggestions for practical teaching links to enable students to better adapt to society and the workplace.

4.4. Adopt diversified quality monitoring and assurance evaluation methods and establish a scientific and regular feedback mechanism

Enriching the carriers of quality culture publicity and using the teaching information feedback system are important means to broaden the channels for collecting teaching quality information. Universities can publicize quality culture through platforms such as campus websites and WeChat official accounts to raise the awareness of teachers and students about teaching quality. At the same time, by using the teaching information feedback system, opinions and suggestions on teaching quality from students, teachers, and parents can be collected promptly to improve the comprehensiveness and accuracy of information collection. In this regard, schools should accelerate the improvement of the construction of the teaching basic state database to provide strong data support for teaching quality analysis. Through the analysis of teaching basic state data, universities can understand teachers' teaching situations, students' learning situations, and the utilization of teaching resources, and discover potential problems and advantages. For example, by analyzing students' examination score data, universities can understand students' mastery of knowledge and identify the weak links in the teaching process. In addition, it is necessary to attach importance to the construction of a scientific and reasonable multi-party quality evaluation mechanism.

4.5. Carry out excellent teaching appraisals to set up model examples

Deeply carrying out activities such as the cultivation of teaching masters and excellent teachers, classroom teaching observation, and activities of basic-level teaching organizations is an effective way to improve teachers' teaching levels. By cultivating teaching masters and excellent teachers, their exemplary and leading roles can be exerted to drive the majority of teachers to improve their teaching levels. Teaching masters and excellent teachers have unique advantages in teaching concepts and teaching methods, and their experiences and practices can be used for reference by other teachers. Based on this, classroom teaching observation activities should be actively organized to provide a platform for teachers to learn from and communicate with each other. In the observation activities, teachers can learn from others' teaching designs and classroom organization skills, promoting the sharing of teaching experiences and the innovation of teaching methods. For example, when carrying out the same-course-different-teaching classroom teaching observation activity, different teachers teach the same teaching content using different teaching methods, and other teachers can learn multiple teaching ideas and methods from it. In addition, the construction of basic-level teaching organizations should be strengthened, and various teaching seminars should be carried out to effectively improve the cohesion and combat effectiveness of the teaching team. Basic-level teaching organizations are the basic units of teaching work. Through teaching seminars, teachers can jointly discuss the problems encountered in the teaching process, share teaching experiences, and jointly improve teaching quality. At the same time, for teachers and courses with problems reflected in the teaching quality feedback, rectification and follow-up should be strengthened. A problem-tracking ledger should be established to regularly check the teachers and courses with problems to

ensure the continuous improvement of teaching quality. For example, for courses with poor teaching effects reflected by students, the school should organize experts to observe classes and provide guidance to help teachers improve their teaching methods and teaching quality.

5. Conclusion

To sum up, the new round of education and teaching audit evaluation brings new opportunities and challenges to the construction of the quality assurance system in universities. Private universities should actively be guided by the chairman of the CCP's Thought on Socialism with Chinese Characteristics for a New Era, adhere to reform and innovation, clarify development ideas, highlight characteristics and innovation points, and solidly promote various practical plans. By constructing a scientific and effective quality assurance system, private universities can improve the quality of undergraduate education and teaching, cultivate high-quality talents that meet the needs of social development, achieve the sustainable development of private universities, and make greater contributions to the prosperity of China's higher education.

Disclosure statement

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Research on the Training Model of Innovative and Entrepreneurial Talents in Universities from the Perspective of “Integration of Specialized and Innovation-entrepreneurship”

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Abstract: The “Integration of Specialized and Innovation-entrepreneurship” emphasizes the in-depth integration of professional education and innovation and entrepreneurship education. It takes professional course teaching as an effective carrier, incorporates the content of innovation and entrepreneurship education, and is committed to cultivating students’ innovative awareness, enhancing their professional and entrepreneurial abilities, and ultimately laying a solid foundation for the comprehensive development of college students. This paper first briefly expounds on the background of the “Integration of Specialized and Innovation-entrepreneurship” education. Then, it analyzes the basic principles that should be followed in the training of innovative and entrepreneurial talents in universities from the perspective of “Integration of Specialized and Innovation-entrepreneurship.” Finally, the paper summarizes and proposes effective paths for the training of innovative and entrepreneurial talents in universities from this perspective, aiming to cultivate more high-quality “specialized and innovation-entrepreneurship” talents by reconstructing the university talent training system and comprehensively improving the education level of universities.

Keywords: Integration of specialized and innovation-entrepreneurship; Universities; Innovation and entrepreneurship; Talent training model

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1. Introduction

With the in-depth promotion of the concept of “mass entrepreneurship and innovation”, universities, as the main front for modern talent training, face new opportunities and challenges in their talent training models. The “Integration of Specialized and Innovation-entrepreneurship” puts forward new requirements for university talent training. Universities should abandon the previous talent training model centered on professional

education and gradually shift towards the in-depth integration of professional education and innovation and entrepreneurship education. Only in this way can students establish correct employment and entrepreneurship concepts, a unique talent training system be created, and the “Integration of Specialized and Innovation-entrepreneurship” be truly promoted to improve quality and efficiency and take root.

2. Background of the “Integration of Specialized and Innovation-entrepreneurship” education

In the context of rapid social development, market demands are becoming increasingly diverse. Especially for enterprises, their demand for innovative talents is particularly urgent. However, it is undeniable that the traditional talent training model mainly based on professional education makes it difficult to meet diverse social needs. Universities, as the main front for cultivating innovative talents, shoulder the arduous task of cultivating students’ innovation and entrepreneurship spirit and improving their innovation and entrepreneurship abilities^[1]. University innovation and entrepreneurship education, as an effective measure to cultivate innovative talents, should receive key attention. On the one hand, it is conducive to cultivating students’ awareness of independent entrepreneurship; on the other hand, it can also enhance students’ comprehensive competitiveness in the market, thus providing a solid talent guarantee and support for the construction of an “innovative” country and laying a solid foundation for the effective implementation of the concept of “mass entrepreneurship and innovation.”

The core content of the “Integration of Specialized and Innovation-entrepreneurship” education in universities is to take professional education as the cornerstone and actively promote innovation and entrepreneurship education, such as team building, investment, financing, laws, and regulations, etc., to broaden students’ horizons, enable them to contact and understand the whole process of entrepreneurship before graduation and lay a foundation for their future career paths^[2-3]. Specifically, there are various ways of “Integration of Specialized and Innovation-entrepreneurship” education. Universities can design a variety of colorful activities based on the actual needs of college students, such as holding entrepreneurship lectures, innovation and entrepreneurship forums, and “Integration of Specialized and Innovation-entrepreneurship” salons, to improve students’ practical abilities. Moreover, universities should pay special attention to college students with a strong willingness to innovate and start businesses, provide them with personalized guidance and support, compile entrepreneurship-related publications, and carefully develop innovation and entrepreneurship guidance manuals for this group. The aim is to help students clarify the obstacles and problems they may face in the process of innovation and entrepreneurship in the future and provide solutions in advance, which is helpful for students to effectively avoid various risks and improve their innovation and entrepreneurship abilities^[4]. The theoretical basis of “special innovation and integration” — the three spiral theory of innovation and entrepreneurship education is shown in **Figure 1**.

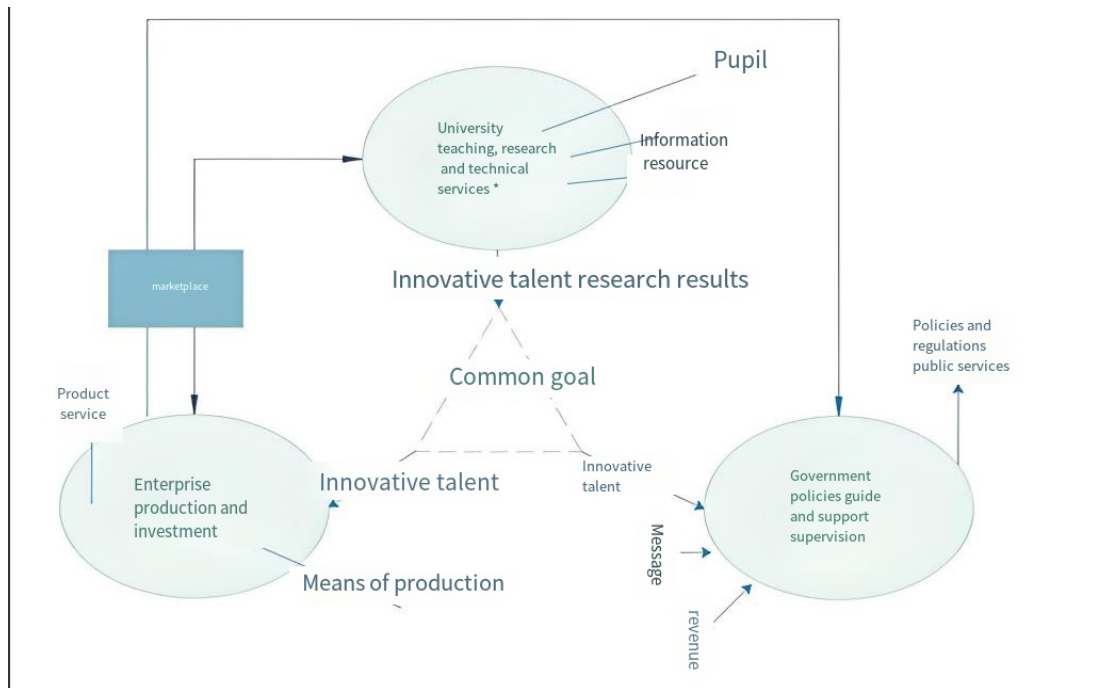


Figure 1. The three-way spiral theory of innovation and entrepreneurship education

3. Basic principles for training innovative and entrepreneurial talents in universities from the perspective of “Integration of Specialized and Innovation-entrepreneurship”

3.1. Main-auxiliary coordination

In the “Integration of Specialized and Innovation-entrepreneurship” education system in universities, professional education is the cornerstone of innovation and entrepreneurship education, and innovation and entrepreneurship education is the expansion and sublimation of professional education. The two complement each other and both play a positive role in the cultivation of “innovation and entrepreneurship” talents. Professional education and innovation and entrepreneurship education have different focuses and have a certain main-auxiliary relationship, but there is no primary-secondary distinction. Generally, professional education plays a dominant role, and innovation and entrepreneurship education play the role of an “assistant.” If universities want to create a scientific and effective training model for innovative and entrepreneurial talents, they should clearly define the relationship between the two, root innovation and entrepreneurship education in the fertile soil of professional education, and fully explore the innovation and entrepreneurship elements hidden in professional education, aiming to promote their in-depth integration ^[5].

3.2. Seamless docking

Aiming to cultivate high-quality “innovation and entrepreneurship” talents, universities should implement the basic principle of “seamless connection.” They should pay attention to all aspects of students’ growth and provide them with the most cutting-edge professional knowledge and information, enrich teaching content, continuously reform and innovate the experimental and practical teaching process, and provide professional support and targeted guidance for students to participate in vocational skill competitions and obtain vocational skill certificates. Only in this way can professional education and innovation and entrepreneurship education

be kept in parallel development, enabling students to firmly master rich innovation and entrepreneurship knowledge and effectively exercise relevant skills through the first and second classrooms, ultimately promoting their comprehensive development ^[6-7].

4. Effective paths for training innovative and entrepreneurial talents in universities from the perspective of “Integration of Specialized and Innovation-entrepreneurship”

4.1. Idea first, strengthen the cognitive orientation of “Integration of Specialized and Innovation-entrepreneurship”

First of all, universities should deepen their understanding of the connotation of innovation and entrepreneurship education to lay a solid foundation for its in-depth integration with professional education in the future. It should be noted that the early innovation and entrepreneurship education policies issued in China had obvious “instrumental” characteristics. However, with the continuous in-depth research on innovation and entrepreneurship education in China, based on rich research results, China has been committed to continuously optimizing and improving the policy system related to innovation and entrepreneurship education. Nowadays, innovation and entrepreneurship education has gradually shifted from “instrumentalization” to “ideation”, emphasizing the cultivation of students’ innovative thinking and spirit, with the fundamental purpose of injecting continuous impetus into students’ career development ^[8]. In this context, to guide the “Integration of Specialized and Innovation-entrepreneurship” in the right direction, universities should continuously deepen their understanding of the connotation of “innovation and entrepreneurship education”, be guided by the fundamental task of “cultivating people with moral integrity”, strengthen school-enterprise cooperation and the integration of industry and education, build platforms and create opportunities for innovation and entrepreneurship education to be closely connected with the production process, and enable students to fully engage in innovation and entrepreneurship practices to enhance their theoretical understanding and improve their practical abilities. Secondly, strengthen the application of the concept of “Integration of Specialized and Innovation-entrepreneurship.” Universities should always implement the talent training principle of “student-centered”, construct an innovation and entrepreneurship talent training model of classified training and guidance, and provide strong support for achieving the educational goals of the “Integration of Specialized and Innovation-entrepreneurship” through a customized curriculum system and practical platform ^[9]. **Figure 2** briefly expounds on the differences between entrepreneurial thinking and traditional education, and aims to lead educators to establish correct educational concepts.

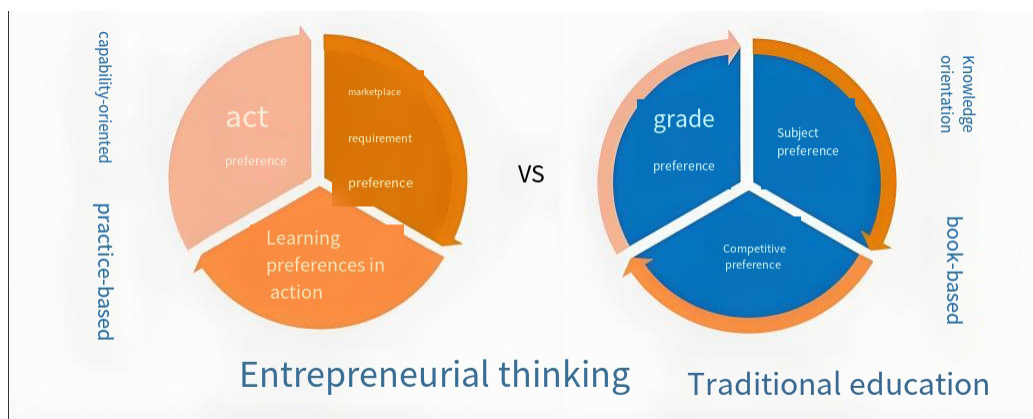


Figure 2. The difference between entrepreneurial thinking and traditional education

4.2. Improve quality, consolidate the foundation of “Integration of Specialized and Innovation-entrepreneurship” education

Universities should build a professional, proficient, and strong teaching team to provide solid support and guarantee the in-depth promotion of the “Integration of Specialized and Innovation-entrepreneurship” education. Given the problems existing in most universities in China, such as teachers lacking rich entrepreneurial investment experience and professional teachers having low innovation and entrepreneurship education capabilities, universities should actively invite successful entrepreneurs or startup founders to participate in the training of innovative and entrepreneurial talents in their own schools. Through their case sharing and practical guidance, the shortcomings of the current teaching staff can be targeted, and the overall practical level of the teaching team can be improved. Specifically, universities can regularly invite entrepreneurs, investors, and entrepreneurs to the school to give special lectures, allowing them to centrally answer the common and individual questions about innovation and entrepreneurship that students care about and provide professional guidance. In this process, investors, entrepreneurs, etc. can also select capable and potential students to participate in actual projects according to their own needs. This can not only provide a stage for students to show their personal talents but also help them accumulate rich practical experience, which is of far-reaching significance for students’ future career development^[10]. In addition, universities should develop practical teacher training and development plans. By regularly organizing seminars, exchange meetings, training sessions, and other activities, teachers can deeply understand the importance and urgency of the “Integration of Specialized and Innovation-entrepreneurship” and actively participate in “Integration of Specialized and Innovation-entrepreneurship” education activities. In this way, the characteristics of “Integration of Specialized and Innovation-entrepreneurship” education can be further highlighted, and more innovative and entrepreneurial talents who are brave to forge ahead and strive hard can be cultivated. On the one hand, universities should actively encourage teachers to “go out”, broaden their horizons, and accumulate experience to feed back into school education and activate the vitality of innovation and entrepreneurship education. On the other hand, universities should establish and improve a teacher incentive mechanism and appropriately reward teachers who have made outstanding contributions in the field of “Integration of Specialized and Innovation-entrepreneurship” education, to create a good atmosphere on campus and actively promote the transformation and upgrading of the university teaching staff.

4.3. Rely on courses, highlight the characteristics of “Integration of Specialized and Innovation-entrepreneurship” education

University entrepreneurship courses are an effective carrier and important platform for cultivating students’ innovation and entrepreneurship spirit. They help students establish correct entrepreneurship and employment concepts and lay a foundation for their future innovation and entrepreneurship paths. To further highlight the characteristics of “Integration of Specialized and Innovation-entrepreneurship” education, the teaching content of university entrepreneurship courses needs to be enriched. On the one hand, the enrollment and employment guidance office of the university can take the lead in creating a series of innovation and entrepreneurship courses tailored to students. Starting from general innovation and entrepreneurship courses, students can be introduced to basic innovation and entrepreneurship activities. Then, the university can create systematic professional-type innovation and entrepreneurship courses, truly exploring the innovation and entrepreneurship elements hidden in professional courses, and specifically cultivating students’ entrepreneurial thinking and

innovative spirit. Finally, based on majors and disciplines and combined with the characteristics of the school, the university should design a series of characteristic innovation and entrepreneurship practical courses and organize relevant practical activities, actively encouraging students to participate in the whole process from planning and founding to operation and management, and effectively improving their practical abilities. On the other hand, relying on platforms such as maker spaces, science parks, and business incubators, universities should actively innovate teaching methods for courses, adopt diversified teaching means such as project-based learning, case analysis, role-playing, and simulated entrepreneurship, and fully stimulate students' learning interests ^[11–12]. Moreover, universities should give full play to the advantages of teaching aids such as artificial intelligence and virtual simulation. By building a digital resource library, rich learning resources can be provided for students. With the help of online lectures and MOOCs, students can directly experience the real scenes of innovation and entrepreneurship, bringing them an immersive feeling and invisibly enhancing the effect of innovation and entrepreneurship education ^[13].

4.4. Strengthen practice, enhance the effect of “Integration of Specialized and Innovation-entrepreneurship” education

The training of innovative and entrepreneurial talents can hardly achieve the desired results by relying solely on theoretical indoctrination. Therefore, under the guidance of the concept of “Integration of Specialized and Innovation-entrepreneurship”, universities should actively guide students to put theory into practice. By providing them with diversified entrepreneurial practice platforms, students' understanding of the connotation of innovation and entrepreneurship can be deepened, and their professional skills can be specifically tempered to cultivate more outstanding “innovation and entrepreneurship” talents. For example, by relying on platforms such as maker spaces and science park incubators, universities can encourage students to carry out project practices freely in groups, helping them accumulate rich practical experience and prepare for future entrepreneurship. Moreover, universities should actively encourage students to participate in various large, medium, and small-scale innovation and entrepreneurship competitions or project applications, providing them with opportunities to truly contact the market and specific projects. Through personal participation in practical activities, students may have a deeper or more unique understanding of the survival and development of enterprises. In addition, the combination of “production, education, and research”, as the core of the “Integration of Specialized and Innovation-entrepreneurship”, is of great significance for cultivating innovative and entrepreneurial talents. Universities can closely cooperate with scientific research institutions, local enterprises, and the government to further implement production-education-research projects and truly transform students' scientific research achievements into practical applications. For example, agricultural universities can pilot and promote students' food research and development projects in the school cafeteria. In this way, it can not only enhance students' sense of professional identity and project pride but also achieve a multiplier effect in education ^[14–15].

5. Conclusion

To sum up, the “Integration of Specialized and Innovation-entrepreneurship” education in universities should be based on professional education. Innovation and entrepreneurship education should be carried out based on professional education, aiming to promote their in-depth integration and maximize the collaborative education

effect. This means that universities should infiltrate the core concept of innovation and entrepreneurship education into all aspects of professional curriculum design and teaching, ensuring that students can not only acquire professional knowledge but also firmly master the practical application ability of knowledge. Moreover, the “Integration of Specialized and Innovation-entrepreneurship” education in universities should also pay attention to maintaining the characteristics of professional education and innovation and entrepreneurship education, focusing on cultivating students’ creative thinking, entrepreneurial awareness, and innovative spirit, and enhancing their comprehensive ability to actively respond to various challenges in the future, to cultivate more innovative talents that meet the needs of society and the country.

Disclosure statement

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Research on the Construction of the “Enrollment-Training-Employment” Tripartite Linkage Mechanism in Application-Oriented Universities: Taking the Landscape Architecture Major of the College of Science and Technology, China Three Gorges University as an Example

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Abstract: Against the backdrop of a new round of scientific and technological revolution and industrial transformation sweeping the globe and the country’s comprehensive promotion of the construction of a quality-strong nation, this paper analyzes the existing problems and their causes in light of the school’s history and actual situation. The paper proposes the main countermeasures for constructing the “enrollment-training-employment” tripartite linkage mechanism. By leveraging the innovative reform practice and demonstration-leading role of pilot majors, it explores the sustainable development path for application-oriented undergraduate universities that can adapt to the changes of the new era, meet the demands for high-quality talents, and effectively improve the quality of talent cultivation in the school, forming a closed-loop of connotative development.

Keywords: High-quality; Employment; Reform; Talent cultivation

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1. Introduction

At present, a new round of scientific and technological revolution and industrial transformation is sweeping the world. Artificial intelligence, mobile Internet, big data, quantum technology, and biotechnology have become the cutting-edge technologies that countries focus on and compete for. The international competition in high-tech fields not only accelerates scientific and technological innovation and iteration but also updates the production and living methods of human society. It also promotes the fundamental transformation of modern

industries from “empowerment” to “intelligence empowerment” and from “quantity” to “quality.” Therefore, to meet the challenges of the new era, promote Chinese-style modernization, and create a new global brand and image of “Chinese quality”, it is necessary to implement the strategy of building a quality-strong nation. Education and talent are important guarantees and fundamental support for this strategy.

On February 6, 2023, the “Outline for Building a Quality-Strong Nation” issued by the Central Committee of the Communist Party of China and the State Council pointed out that in the face of the new situation and requirements of the world today, it is necessary to shift the focus of development to improving quality and efficiency, cultivate new economic development advantages with technology, standards, brands, quality, and services as the core, promote the transformation of “Made in China” to “Created in China”, “China Speed” to “China Quality”, and “Chinese products” to “Chinese brands”, and unswervingly promote the construction of a quality-strong nation ^[1]. It also requires that “quality-related content be incorporated into compulsory education in primary and secondary schools, higher education institutions be supported to strengthen the construction of quality-related disciplines and the setting of majors, the vocational training system and professional title system for quality-related technical and skilled talents be improved, and the effective connection between the professional title system and the vocational qualification system be achieved, to focus on cultivating quality-related skilled talents, scientific research talents, and business management talents. A quality policy evaluation system should be established to strengthen result feedback and follow-up improvement.” In the “Notice of the Ministry of Education on Doing a Good Job in the Employment and Entrepreneurship of Graduates from National Regular Institutions of Higher Education in the Class of 2023”, it is also clearly required that “local governments and universities should establish and improve an effective linkage mechanism between employment, enrollment, and training, and take the employment situation of college graduates as an important part of the adjustment of the higher education structure” ^[2].

Whether from the perspective of the demand for innovative talents in the era of change or from the perspective of the quality of talent cultivation that determines the survival and development of universities themselves, the comprehensive reform of universities, which is oriented by the employment market and talent demand, aims at high-quality talent cultivation and takes the integration of industry and education as the main means, is an inevitable path and an important guarantee for constructing the “enrollment-training-employment” tripartite linkage mechanism. Internationally, the cooperation and development between higher education institutions and the industrial sector started relatively early. There are relatively mature experiences in the research and practice of the integration of industry and education to enhance mutual assistance and interaction, improve teaching quality, and promote innovation and entrepreneurship. The cooperation between German higher education institutions and the industrial sector focuses on the fields of technology and engineering, and they jointly carry out highly targeted and practical research projects. American universities and the industrial sector highlight the cultivation of innovation-driven and entrepreneurial spirit in their cooperation, forming a relatively complete innovation and entrepreneurship education system. The cooperation between British higher education institutions and the industry has its uniqueness in interdisciplinary and cross-organizational knowledge transfer ^[3]. At the same time, in terms of guarantee measures such as policies, regulations, and institutional organizations, the advanced practices of European and American countries can also provide a reference value for the cultivation of high-quality talents through the integration of industry and education in China.

2. Current situation and causes

2.1. Development status

As a local application-oriented university with a history of more than 20 years and in the process of transformation and upgrading, the school has a large scale of teachers and students, a stable source of enrolled students, and rich educational achievements. It has a complete range of disciplines, standardized education and teaching, a good social reputation, and comprehensive development of students. In recent years, the school has seized opportunities to accelerate the development of transformation and comprehensive reform, continuously deepened teaching reform, improved teaching quality, and comprehensively promoted the educational concept in the new era of “full-employment, integration of industry and education, adaptation to the times, and service to local areas.” However, it should also be noted that in today’s era of increasing technological innovation and rising employment difficulties, the school has problems such as being divorced from the market, lacking innovation, having single-dimensional abilities, and being insufficiently adaptable in terms of professional structure, training models, and graduates’ abilities, which is not conducive to the healthy development of our school’s higher education.

2.2. Problems and causes

2.2.1. Main problems faced currently

With the transformation of industries and the change of technologies, the school faces increasingly fierce employment competition for graduates, growing employment difficulties, and a prominent imbalance between the supply and demand of talents, with the “labor shortage” in enterprises and the “employment difficulty” of graduates. The overall number of employment positions has decreased, and students’ employment awareness is weak. Traditional industries and some majors are greatly impacted by the market, resulting in insufficient applicants and low employment confidence. The comprehensive qualities and professional abilities of graduates do not match the social demand. The development of enrolled majors is unbalanced, and the proportion of the number of students in “popular” majors and other majors is seriously uncoordinated ^[4].

2.2.2. Analysis of the causes of the problems

Since the implementation of the college enrollment expansion policy in 1999, the number of college graduates has increased by more than 10 times in over 20 years. At the same time, the economic transformation and technological changes in the new era have led to a continuous reduction of employment positions in traditional industries, which has become the main reason for the increased employment competition pressure on graduates. This, in turn, has led to frequent employment avoidance psychology among students, a lack of employment motivation, and insufficient career awareness. When facing employment choices such as taking the postgraduate entrance examination, taking the civil service examination, seeking direct employment, or starting their own businesses, students generally have serious blindness and herd mentality. In terms of talent intake, society’s incomplete and irrational understanding of “popular” majors, and in talent cultivation, the disconnection between education and teaching and industry development also restrict the sustainable and healthy development of our school and the quality of talent cultivation.

3. Countermeasures

3.1. Construct the “Enrollment-Training-Employment” tripartite linkage mechanism to promote the integration of production, education, research, and application

Implement the “Talent-Priority Development Strategy”, keep up with the needs of the times and market

changes, seize the opportunity of the school's transformation and upgrading, and promote the implementation of the special action of "deepening teaching reform and student-affairs reform, focusing on improving the quality of talent cultivation, and comprehensively promoting full employment of college students". Take the pilot reform majors as the starting point, rely on and connect with local enterprises and public institutions. Through deepening teaching reform and constructing the "enrollment-training-employment" linkage mechanism, effectively form a closed-loop system for the "talent intake, training process, and talent output" of universities, align the goal of comprehensively promoting employment work with the talent demands of local construction and industrial services, and promote the "full-staff, whole-process, and all-around" education and employment of universities and local areas/enterprises (**Figure 1**).

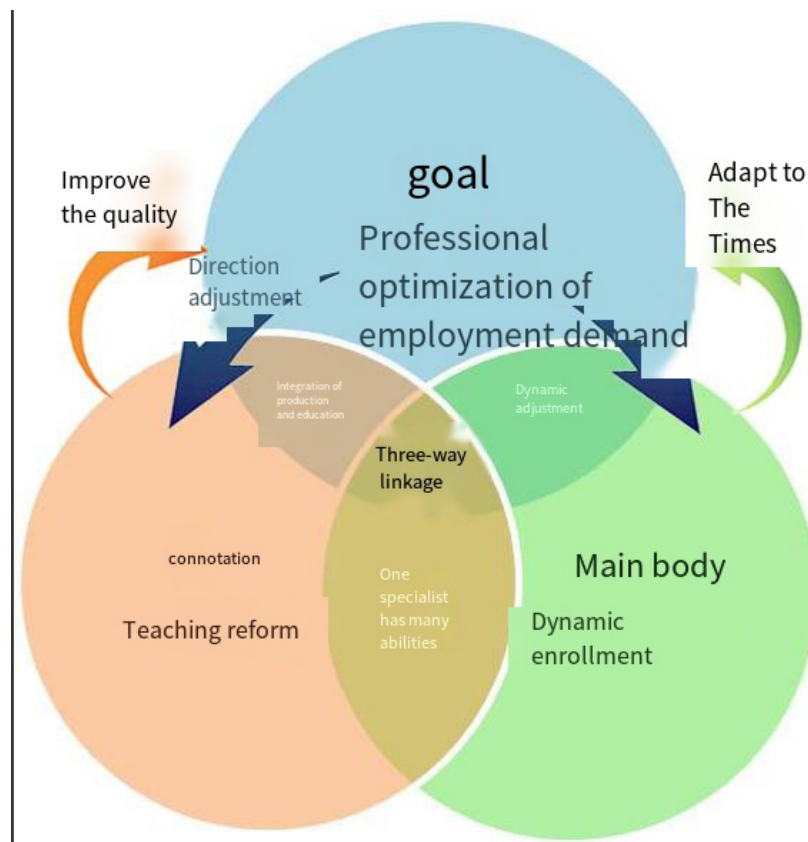


Figure 1. Three-way linkage mechanism of enrollment, training, and employment

3.2. Form a whole-process career planning education integrating “Entrance Education, Professional Teaching, and Employment Guidance”

Career planning education is an important means to help students comprehensively understand the changes of the times, industry trends, social demands, and career development based on their understanding of majors, and correctly establish a rational and comprehensive career outlook, employment outlook, and career-selection outlook. Single-session course teaching alone cannot achieve satisfactory results. Through the full cooperation of full-time teachers, employment tutors, and professional leaders, a joint force for career planning education can be formed in various links, throughout the whole process, and through multiple channels, such as freshman entrance education, curriculum ideology, and politics in professional courses, compulsory career development

courses, and graduate employment guidance, to create a multi-dimensional and three-dimensional employment guidance and assistance system^[5-6].

3.3. Deepen teaching reform and implement the transformation of cultivating high-quality “Versatile and Multidisciplinary” talents

The cultivation process is a key link in high-quality talent cultivation and has an important connotation for improving the employment ability of college graduates and the quality of enrolled students. “Versatile” requires students to expand their professional skills, predict industry development, and adapt to market changes. “Multidisciplinary” requires students to have innovative practical abilities, interdisciplinary integration capabilities, and comprehensive quality^[7]. The traditional teaching model in universities can hardly meet the needs of industrial transformation and industry upgrading in today’s era. With the goal of “updating knowledge reserves, closely connecting with industries, adjusting employment directions, optimizing training models, strengthening the proportion of practice, and stimulating innovative thinking”, schools should promote curriculum construction and teaching reform to fundamentally solve the problem of imbalance between talent supply and demand.

4. System construction and educational practice

4.1. The goal of the “Enrollment-Training-Employment” linkage mechanism: employment-demand-oriented

Professional leaders and the enrollment and employment department jointly conduct in-depth research in enterprises, pay attention to current industry development, market changes, and employment demands, change the inherent understanding of employment directions, and actively expand various cooperative enterprises and public institutions and new job positions for this major. Based on the two major types of enterprises, landscape design and garden construction, cooperative enterprises in “multi-dimensional and new business forms” such as garden management, cultural tourism, seedling cultivation, digital industry, and intelligent construction are added, laying a foundation for implementing the new educational goal of “teaching students in accordance with their aptitudes and promoting their all-around development” for students majoring in this field and promoting the integrated training model of “cultivation through industry-education integration and direct access to internships and employment.”

Taking the needs of the times as the orientation and using it as the guiding principle for adjusting the talent-cultivation direction and improving students’ abilities. Organize and complete the compilation of a new version of the talent-cultivation plan corresponding to the “enrollment-training-employment” linkage mechanism, further optimize the proportion of theoretical and practical links, and open up windows for the integration of industry and education and school-enterprise joint teaching. Adjust the talent-cultivation goals and the directions of ability and quality of each major in a timely manner according to the changes of the times and industrial transformation, seek new “tracks” for employment and entrepreneurship, and endow students with the ability to “adapt to changes and take the initiative to change.”

Taking the employment outlet as the orientation and using it as the basis for the dynamic adjustment of discipline setting, student-source plans, and professional structures. In terms of discipline setting, give full play to the role of macro-control of market demands, timely update, transform, shut down, or add majors, and actively explore the development path of multi-disciplinary integration of “Digital +” and “Internet +.” In terms

of student-source plans, on the one hand, reasonably adjust the enrollment plans of majors according to talent demands and employment data. On the other hand, based on the big data of employment destinations and the industry development in student-source areas, more targeted student-source plans can be allocated. In terms of professional structures, optimize the ratio of undergraduate and junior college programs, give full play to the advantages of industrial colleges in cultivating vocational-skilled talents and providing direct access to employment, and form a new paradigm of discipline development for the integrated construction of production, education, and research ^[8].

4.2. The main body of the “enrollment-training-employment” linkage mechanism: Dynamically adjusted enrolled students

Taking the “comprehensiveness, interdisciplinarity, applicability, and flexibility” of the landscape architecture discipline of the pilot major as its characteristics and advantages, plan to gradually construct a “sustainable development” professional structure system that integrates planning, design, tourism, entertainment, and cultural and creative industries, including “smart cities, digital villages, modern cultural tourism, forest health care, virtual reality, and visual branding”. This system features interdisciplinary integration, complementary undergraduate and junior-college levels, and school-enterprise joint construction, which is more conducive to coping with market changes in the industry and dynamically adjusting the composition of students within the professional system in a timely manner.

Based on the analysis of big data on enrollment sources over the years and the analysis of big data on the employment destinations of graduates, flexibly adjust the enrollment plans in student-source areas and the destinations for visiting enterprises and expanding job opportunities. The natural resources, economic advantages, and industrial layouts of different regions and provinces vary. Therefore, the cognitive and acceptance levels of students and parents in different regions towards different industries will directly affect their major choices and career plans. At the same time, different regions also have significant differences in talent demands for graduates of different majors. Analyzing big data can make the allocation of student-source plans for different majors in different provinces more accurate and scientific, and also help to develop the employment market more targeted ^[9].

Learn from the successful experience of school-enterprise cooperation models such as successful industrial colleges and order-based classes, and innovate and transform traditional enrollment and training models. Industrial colleges can integrate the respective advantageous resources of schools and enterprises. Through models such as joint teaching, on-the-job internships, production and research and development, and order-based training, they can highly integrate and complement the trend hotspots, technological innovations, and employment channels of the industry with the theoretical basis, academic research, and environmental facilities of universities. Learn from domestic and provincial universities and enterprises that have successfully established and are operating industrial colleges, implement the construction of innovative industrial colleges in the pilot colleges and majors of the school, and gradually promote the modern educational practice experience of industry-education integration throughout the school, ultimately completing the comprehensive update of the high-quality talent-cultivation model for application-oriented universities.

4.3. The connotation of the “Enrollment-Training-Employment” linkage mechanism: Innovative teaching reform

Encourage the professional leaders and teaching teams of pilot majors to take the lead in and continuously carry

out teaching reform, curriculum construction, and professional optimization. Conduct in-depth and thorough reform, innovation, and teaching practice starting from aspects such as the adjustment of talent-cultivation plans, curriculum setting, teaching methods, teaching content, assessment methods, curriculum ideology and politics, and the construction of three types of classrooms. Connect the knowledge points of professional courses with national policies, industry trends, local construction, and enterprise projects, update the talent-cultivation directions and the goals of ability and quality in a timely manner, and implement the cultivation of innovative and application-oriented talents to meet the needs of the times and industry development ^[10-11].

Break the boundaries of disciplines, form interdisciplinary teaching teams across academic divisions and schools, gradually introduce new majors, new directions within the discipline, or interdisciplinary and dual-qualified young talents, and widely invite industry experts and technical backbones to serve as part-time teachers to participate in all aspects of curriculum teaching, discipline construction, internship practice, teaching and research, discipline competitions, and employment guidance. Build a teaching reform and innovation guarantee through the construction of a teaching staff with a reasonable structure, cross-border innovation, and a local-based focus ^[12].

Continuously promote the transformation of scientific research achievements into teaching to provide sustainable vitality for innovative teaching reform. Taking the landscape architecture major of our university as an example, encourage the discipline team to form a joint force in scientific research directions such as “beautiful countryside, urban renewal, intelligent construction, land use planning, and cultural and tourism planning”, as well as in teaching and research directions like “new engineering construction, high-quality employment, and practical education”, and are committed to cultivating “versatile” talents ^[13].

5. Achievements of reform and construction

5.1. At the overall school level

Through the work deployment of “two reforms and one action”, namely, deepening innovative teaching reform, deepening student management reform, and promoting high-quality employment, the employment-oriented work goals and focus have been determined in the institutional aspect. By establishing the College Students’ Development and Employment Guidance Center and selecting class teachers, the educational concept of “full-employment and whole-process, all-round, and all-staff education” has been implemented in terms of personnel. In recent years, the employment rate of the school has significantly increased, the enrollment acceptance rate has steadily improved, and the rudiment of the “enrollment-training-employment” mechanism has taken shape ^[14].

5.2. At the individual discipline level

5.2.1. Dynamic adjustment of enrollment and admission

The landscape architecture major updates its enrollment brochures and training orientations every year to meet the needs of the times. Based on the analysis of big data on enrollment and employment over the years and the business forms in the student-source areas, it timely adjusts the student-source placement plans in relevant provinces and cities. The number of enrolled students has been increasing year by year in the past three years, and the number of students currently enrolled has become more stable. The number of students majoring in this field in the class of 2024 is twice that of the class of 2022.

5.2.2. Teaching reform and talent cultivation

The landscape architecture major took the lead in implementing the spirit of the school's "two reforms and one action" work, promoting the case-based teaching model of "alternating in-class and out-of-class learning and integrating theory with practice." In the assessment of the completion of the first-round pilot reform, all 5 pilot courses of this major passed, with 3 of them receiving excellent grades, playing a good exemplary and leading role within the school. It actively promotes the integration of industry and education and serves the local area. It has carried out in-depth cooperation with the Yichang Landscape Architecture Society in discipline construction, curriculum teaching, academic activities, internship, and employment. A large number of enterprise experts have been invited to participate in various aspects of professional education and teaching, taking the initiative to contribute to local urban renewal and rural revitalization. The comprehensive abilities of students and the learning atmosphere have been continuously improved. The teaching achievements have generated direct social benefits and have been highly recognized by local governments, enterprises, and public institutions ^[15].

5.2.3. High-quality employment and demand-orientation

The teaching team of the landscape architecture major has continuously conducted in-depth research and visits in the industry and enterprises explored and identified the growth points of new-quality productive forces and new employment directions for this major, and continuously expanded the cooperative enterprises for direct internships and employment. It fully integrates career planning and employment guidance into entrance education, professional course teaching, and extracurricular activities, and persists in strengthening and enhancing students' employment awareness and professional identity. The employment rate of landscape architecture graduates in the class of 2022 reached 95%, and the postgraduate entrance examination admission rate reached 10%. In the class of 2023, the employment rate reached 98%, the postgraduate entrance examination admission rate reached 12.5%, and the civil service admission rate reached 6%. In the class of 2024, the employment rate reached 95%, the postgraduate entrance examination admission rate reached 13%, and the civil service admission rate reached 6%.

6. Deficiencies and prospects

6.1. Existing deficiencies

Affected by the current transformation and transition stage of the school, the "enrollment-training-employment" mechanism of this major is not yet complete and mature. The current educational framework and enrollment levels of the pilot major are still in a single state, with weak resilience. The employment-outlet units and industry-education-integrated enterprises mainly come from the local city, with limited talent demand, which is not conducive to the sustainable and healthy development of this major. Restricted by factors such as funds, safety, systems, and frameworks, the talent-training model and innovative teaching reform have not achieved the expected results, and the "integration of production, education, research, and application" is still in its infancy.

6.2. Goals and prospects

The "enrollment-training-employment" tripartite linkage mechanism is the key to realizing the closed-loop of connotative development in application-oriented universities. It needs to be continuously constructed and optimized in the following aspects.

Pay attention to industry development trends, seize the opportunity of the college's transformation, prepare well for the application of new undergraduate and junior college majors, and plan in advance a more reasonable and comprehensive educational framework and professional levels to lay a solid foundation for dynamic enrollment.

Further expand cooperation with enterprises and public institutions in landscape design, garden construction, municipal engineering, greening management, digital media, cultural and tourism planning, intelligent construction, etc., as well as the resources of universities that enroll postgraduate students majoring in landscape architecture, environmental design, horticultural plants, territorial spatial planning, architecture, etc., to broaden the channels for employment and further study.

Based on this major and related majors, refer to the talent-training models of mature industrial colleges, improve the "industry-education integration and practical education" system and regulations, deepen cooperation with local industries, continuously promote the "integration of production, education, research, and application", and do a good job in the connection of the upstream, midstream, and downstream to provide guarantee for talent cultivation.

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Disclosure statement

The authors declare no conflict of interest.

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Exploration and Practice of Ideological and Political Teaching Reform in the Course of “Residential Landscape Design” in the New Era

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Abstract: In the era of real estate stock, facing people’s aspiration for a better life, residential landscape, as the environment most closely related to people’s lives, how to meet people’s dreams of living environment in the new era in design has become an important research content. This article will conduct an in-depth analysis of the background, overall ideas, teaching design, practical effectiveness, and other aspects of the ideological and political teaching reform of the “Residential Landscape Design” course. It explores how to guide students to pay attention to people’s livelihood issues, cultivate students’ awareness of serving the people, their ability to design for the people, and their sense of responsibility to love the people under the guidance of Xi Jinping’s educational ideology in the new era.

Keywords: New era; Residential landscape design; Curriculum ideology and politics; Teaching reform

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1. Introduction

“Residential Landscape Design” is one of the main courses in the landscape design direction of environmental design major. It is a landscape design course that combines theory with practice and features project-based learning. The course focuses on residential landscape design as the research object. By comprehensively applying various teaching methods such as theoretical instruction, case analysis, project practice, induction, and summation, it requires students to master the principles and methods of residential landscape design, enabling them to design residential landscape plans and present the results. The “Outline of the Construction Plan for Strengthening Education and Building a Powerful Nation (2024–2035)” states, “Shape a new pattern of cultivating moral integrity and talent, and nurture newcomers of the era who are responsible for national rejuvenation”^[1]. The course “Residential Landscape Design” focuses on the environmental spaces where people live and is therefore closely related to the interests of the people. Whether students pay attention to people’s livelihood issues, possess the awareness of serving the people, and love the people is crucial to the

success of the course teaching. Therefore, the course uses project design tasks as the main carrier, integrating ideological and political elements into the curriculum. It guides students to complete innovative residential environment designs centered on the people, cultivating their ability to design living environments that meet the needs of people's dreams for the environment. This includes creating a comfortable and safe living space, improving and facilitating infrastructure, establishing a sound public service system, ensuring a beautiful and sustainable ecological environment, promoting community harmony and integration, implementing intelligent and digital management, and inheriting and innovating cultural heritage. The main teaching objective of this course is to cultivate newcomers of the era with a sense of mission and responsibility.

2. Background of ideological and political teaching reform in residential landscape design course

The ideological and political teaching reform of the “Residential Landscape Design” course is primarily guided by national policies, based on the development needs of the industry, aimed at improving students' comprehensive qualities and grounded in the content of residential landscape design to construct the teaching content. The specific reform background and basis mainly include the following five points. Firstly, the Political Bureau meeting in September 2024 clearly stated that the construction of commercial housing should “strictly control the increment, optimize the stock, and improve quality.” China's real estate market is gradually shifting from incremental development to quality improvement of the existing stock. Therefore, the teaching content of residential landscape design, which focuses on newly built commercial housing, cannot meet the dynamic needs of industry development, making reform imperative. Secondly, in 2021, the Ministry of Housing and Urban-Rural Development issued the “Notice on Launching the First Batch of Pilot Work for Urban Renewal” (Jianban Kehan [2021] No. 443), initiating the exploration of urban renewal^[2]. In January 2025, the Executive Meeting of the State Council pointed out that urban renewal is related to the improvement of the city's appearance and living quality, urging the acceleration of the renovation of old residential areas, blocks, factories, and villages in cities and towns, strengthening the construction and renovation of urban infrastructure, improving urban functions, and protecting and inheriting the city's history and culture^[3]. Thirdly, the strategy of rural revitalization was proposed in the report of the 19th National Congress of the Communist Party of China in October 2017^[4]. In February 2024, Central Document No. 1 proposed learning from the experience of the “Thousand Villages Demonstration and Ten Thousand Villages Renovation” project to effectively promote comprehensive rural revitalization. Fourthly, in July 2024, the Third Plenary Session of the 20th CPC Central Committee proposed “increasing the construction and supply of affordable housing to meet the rigid housing demand of the working class.” At the end of the same month, the State Council issued the “Five-Year Action Plan for Deeply Implementing the People-Oriented New Urbanization Strategy”, and accelerating the construction of affordable housing was also listed as one of the key tasks, emphasizing the need to “accelerate the resolution of housing difficulties for the working class and stabilize their housing expectations”^[5]. Fifthly, in May 2022, the Ministry of Civil Affairs and eight other departments jointly issued the “Opinions on Further Promoting the Construction of Smart Communities”, which clearly stated that by 2025, a smart community service platform supported by informatization and open sharing should be basically established, creating a new type of digital community with smart sharing and harmonious co-governance^[6]. Therefore, guided by the above national policies, the renovation of old urban areas, landscape design for affordable housing, rural residential landscape design, and high-quality

smart community landscape design will become the key research content of “Residential Landscape Design.”

3. General idea of ideological and political teaching reform in residential landscape design course

The ideological and political teaching reform of the residential landscape design course adheres to the guidance of Xi Jinping’s new era education thought, adheres to the ultimate goal of making virtue and cultivating people, adheres to the correct values of the times to guide the transformation of design technology, integrate the current situation of national conditions, policy guidelines, etc. into the course teaching, closely follow the national policy, closely follow the course content, focus on people’s livelihood issues, and build five themed teaching units, namely, the overview of residential landscape design, urban old residential landscape renovation, rural residential landscape design, affordable housing landscape design, and high-quality smart residential landscape design. Combine theory and practice, apply what one has learned, and lead students to complete the innovative residential landscape design practice centered on the people. Ideological and political education nurtures people and gradually cultivates students’ aesthetic, cultural, ecological, and people’s views. **Table 1** shows the main points of ideological and political elements.

Table 1. Curriculum ideological and political element framework

No.	Ideological and political theme	Ideological and political key points	Integration theme unit	Teaching content
1	New era living environment dream	1. Livable and comfortable environment dream (people’s livelihood awareness); 2. Healthy and sustainable ecological environment dream (ecological protection awareness); 3. National cultural characteristic environment dream (traditional culture protection awareness); 4. Innovation awareness; 5. Standardization awareness.	Overview of Landscape Design in Residential Area.	1. Initial knowledge of residential area landscape design; 2. Influencing factors of residential area landscape design; 3. Functions of residential area landscape design; 4. Brief description of the development of residential area landscape design; 5. Residential area landscape design specifications.
2	People’s cities are built by people, and people’s cities are built for the people.	1. Moral and ethical literacy; 2. Political theory literacy; 3. National conditions awareness; 4. Innovation awareness.	Landscape Renovation Design of Old Residential Area under the Background of Urban Renewal.	1. Case appreciation; 2. Project design practice; 3. Project design reflection.
3	The nation must be rejuvenated, and the countryside must be rejuvenated.	1. patriotism education; 2. ecological civilization education; 3. social responsibility training.	Landscape Design of Rural Residential Area under the Background of Rural Revitalization.	1. Case appreciation; 2. Project design practice; 3. Project design reflection.
4	Caring for low-income people, pursuing social fairness and justice.	1. The embodiment of social fairness and justice; 2. The concept of people’s livelihood; 3. The spirit of responsibility.	Landscape design of affordable housing under the background of housing dual-track policy.	1. Case appreciation; 2. Project design practice; 3. Project design reflection.
5	Technology empowers the community, and technology serves the people.	1. People’s livelihood awareness; 2. Innovation awareness.	In the context of smart technology development, high-quality smart community landscape design.	1. Case appreciation; 2. Project design practice; 3. Project design reflection.

4. Ideological and political education design in residential area landscape design course

The ideological and political education design in the residential area landscape design course revolves around five major teaching content areas, integrating five key ideological and political themes. These themes are: the dream of a human settlement environment in the new era; people's cities built by the people and for the people; national revitalization through rural revitalization; caring for low-income people and pursuing social fairness and justice; and community empowerment and service through technology. Details are as follows.

4.1. Ideological and political theme 1: The dream of living environment in the new era

Wu Liangyong systematically outlined in his book "Introduction to the Science of Human Settlements" that a human settlement environment should consist of five aspects: natural systems, human systems, residential systems, social systems, and support systems. The dream of a human settlement environment in the new era represents the people's pursuit of a better life, harmonious coexistence between humans and nature, and a new pattern of social governance featuring collaborative development, shared governance, and common interests.

4.1.1. Integration points of ideological and political education

Combining the overview of residential area landscape design in Theme Unit 1, the course introduces concepts, influencing factors, functions, developments, and standards of residential area landscape design. This leads students to reflect on the new requirements of the dream of a human settlement environment in the new era for residential area landscape design, incorporating ideological and political elements such as below.

People's livelihood awareness: Understanding China's national conditions and development realities, interpreting contemporary life, analyzing livelihood issues, and summarizing functional requirements that meet people's new needs to create a livable and comfortable human settlement environment.

Ecological protection awareness: Deeply understanding environmental issues and recognizing the importance of environmental protection. Applying eco-design concepts to create a healthy and sustainable ecological human settlement environment.

Traditional culture protection awareness: Combining analysis of the current situation of ubiquitous residential environments, deeply understanding the regional cultural characteristics and traditional Chinese culture of "one place nourishing its people" to create a human settlement environment with regional and ethnic cultural characteristics.

Innovation awareness: Considering the contemporary value of residential area landscapes. To adapt to social development and changes in people's needs, designers should have innovative spirits and abilities, continuously exploring new concepts, technologies, and methods to promote innovation and development in human settlement environment construction.

Regulatory awareness: Focusing on explaining green space ratios and fire safety regulations, initiating thoughts and discussions on safe and comfortable landscape space design methods, and fostering students' regulatory awareness and professional mission.

4.1.2. Educational methods and carrier pathways

This theme unit primarily consists of theoretical lectures, combined with discussions, case studies, and after-

class extensions to form a closed-loop learning experience. Specific steps include:

Pre-class reflection: Setting up short videos related to the dream of a human settlement environment in the new era to stimulate student reflection.

In-class introduction: Discussing students' understanding of new requirements for residential environments in the new era.

Theoretical teaching: Guiding students to understand China's national conditions, policy directions, and livelihood issues, laying a theoretical foundation for creating a human settlement environment that meets the needs of the Chinese people.

Case study appreciation: Using case analysis and discussion to intuitively guide students in understanding new requirements for residential environments.

Classroom discussion: Adopting a "one lesson, one discussion" format to encourage active thinking and discovery.

Post-class reflection and assignments: Assisting students in reflecting on and extending classroom content, with assignments focusing on case study analysis.

4.1.3. Expected teaching outcomes

Students will be able to articulate the new requirements of the dream of a human settlement environment in the new era for residential area landscape design. In their practical design work, students will implement a "people-oriented" design philosophy, creating beautiful and livable human settlement environments.

4.2. Ideological and political theme 2: People's cities are built by the people, and people's cities are built for the people

In November 2019, the chairman of the CCP first put forward the concept of "People's cities are built by the people, and people's cities are built for the people" during his inspection in Shanghai, emphasizing that "whether it is urban planning or urban construction, whether it is the construction of new urban areas or the reconstruction of old urban areas, the government must adhere to the people as the center, focus on the needs of the people, and rationally arrange production, living, and ecological space." "Strive to create a good environment suitable for business, livability, pleasure and tourism" [8].

4.2.1. Integration points of ideological and political education

In the context of Theme Unit 2, which focuses on the landscape renovation design of old residential areas under the background of urban renewal, students are prompted to reflect on and comprehend national policies, traditional culture protection, and regional characteristic inheritance through case appreciation, project design practice, and reflection. These understandings are then applied to the practical design of landscape renovations in old residential areas. Specifically, the following ideological and political elements can be integrated into teaching:

Ethical and moral accomplishment: Respect and protect the interests of residents in the design, ensuring that renewal projects can truly benefit them.

Political theoretical attainment: Any design should align with national political requirements and development directions, demonstrating an awareness of actively understanding and mastering national political theories.

National conditions awareness: Designs should be based on national conditions and development realities. Designers should possess a deep patriotic sentiment, ensuring that renewal projects meet the country's development needs and people's expectations.

Innovation awareness: Design is a process of identifying and solving problems, requiring continuous exploration of new solutions. Designers need to possess an innovative consciousness and spirit to better renovate and design old residential areas.

Cultural inheritance awareness: The renovation of old residential areas should fully respect site characteristics, highlight regional features, and inherit traditional culture.

4.2.2. Educational methods and carrier pathways

The main methods adopted in this theme unit are case appreciation, task-driven learning, and inductive summarization. Through case appreciation, students learn the key points and design methods of old residential area renovations. These are then applied and tested through project design practice, and finally, the theory is summarized through project design reflection. The process can be divided into the following steps:

Pre-class reflection: Set up short videos about urban renewal to stimulate student reflection.

Case appreciation: Select representative city residential area renewal project designs for case analysis and discussion. For example, the landscape renovation design scheme for the “Slow Life + Light Leisure” residential, tourism, and industrial complex in the Ma’anshan Shangxin Street community. This project utilizes Chongqing’s spatial language, learns from history and modern urbanism, finds connections between tradition and modernity, focuses on people, pays attention to diverse population demands, settles on the home, enhances a sense of home identity, and experiences the story of Longmenhao, Chongqing people, mountain city stories, and the daily life of historical Chongqing.

Class discussion: Analyze the aspects of renewal design in the case, its characteristics, and whether it meets the requirements of the new era’s human settlement environment dream. Summarize the key points of landscape renovation design for old residential areas under the background of urban renewal.

Project design practice: Provide topics for landscape renovation design of old residential areas with cultural characteristics for students to choose from, guide students to complete project design schemes, and focus on guiding the following aspects in each step.

Firstly, research. Through research, students conduct field investigations to analyze the cultural characteristics and current issues of the base, experience people’s lives, understand people’s demands through interviews, and lay a factual basis for project design.

Secondly, the design of landscape renovation schemes for old residential areas. The main focus is on how to solve the following problems: How to improve residents’ quality of life and promote sustainable city development through project design and renovation in the face of issues such as aging infrastructure, environmental pollution, and traffic congestion; How to enhance the city’s image and attractiveness through renovation design; How to protect historical culture, inherit regional cultural characteristics, and enhance city quality in renovation design.

Thirdly, design scheme reporting and communication. Guide students to focus on people’s needs, identify design positioning around the problems that need to be solved in residential area renewal, elaborate design ideas, express their thoughts and solutions on urban renewal, propose suggestions and methods for optimizing and improving design schemes, and cultivate students’ communication skills, logical thinking

ability, and inductive summarization ability.

Project design reflection: The first is a reflection after each lesson, followed by a specialized comprehensive review and reflection on the scheme after the project design is completed. This guides students to reflect on the deficiencies and optimization directions of the scheme design in solving the problems faced by residential area renewal, further strengthening students' design ability and awareness of "designing for the people."

Assessment indicators: Whether the direction of the old residential area renewal design scheme addresses the issues that need to be solved in urban renewal and meets the needs of the new era's human settlement environment dream is included in the assessment and evaluation elements, guiding students to establish a design awareness of "respecting historical culture and designing for the people."

4.2.3. Expected teaching effectiveness

Students are expected to demonstrate the following abilities in the landscape renovation project design of old residential areas. They can reasonably analyze the SWOT in the project and accurately identify the project positioning that meets the requirements of urban renewal. In the scheme design, students can practice "bringing well-being to residents, enhancing the city's image, revitalizing existing space, and inheriting historical culture."

4.3. Ideological and political theme 3: For the nation to revive, the countryside must be revitalized

The 2021 Central Document No. 1 states: "For the nation to revive, the countryside must be revitalized" ^[9]. People must persist in treating the resolution of issues concerning agriculture, rural areas, and farmers as the top priority of the entire party's work, comprehensively promoting rural revitalization as a major task for achieving the great rejuvenation of the Chinese nation, and accelerating the modernization of agriculture and rural areas with the efforts of the whole party and society, so that the majority of farmers can live a better life.

4.3.1. Integration points of ideological and political education

In the context of Theme Unit 3, which focuses on rural residential landscape design under the background of rural revitalization, students are prompted to reflect on policy guidelines, regional cultural inheritance, issues concerning agriculture, rural areas and farmers, farmland protection, ecological protection, and other aspects through case appreciation, project design practice, and reflection. These understandings are then applied to the practical design of rural residential landscapes. Specifically, the following ideological and political elements can be integrated into teaching:

Patriotism education: Guide students to deeply understand that issues concerning agriculture, rural areas, and farmers are fundamental to the national economy and the people's livelihood, stimulate students' patriotic feelings, and promote students' ability to consciously and actively participate in rural revitalization.

Ecological civilization education: Guide students to understand that the transformation and upgrading of rural development first requires ensuring food security and protecting farmland. Secondly, it is necessary to protect regional historical and cultural resources and inherit regional characteristics. Finally, attention should be paid to ecological environmental protection. Cultivate students' concept of ecological civilization and enhance their awareness of environmental protection and sustainable development.

Cultivation of social responsibility: Rural revitalization is a major national strategy that requires the joint participation and efforts of all parties. Guide students to think about how to contribute wisdom and strength to rural revitalization as landscape designers, cultivate students' social responsibility, and promote students to pay more attention to social issues and actively participate in public welfare undertakings.

4.3.2. Educational methods and carrier pathways

The main methods adopted in this theme unit are case appreciation, task-driven learning, and inductive summarization. Through case appreciation, project design practice, and reflection, students learn the key points and methods of rural residential landscape design. The process can be divided into the following steps.

Pre-class reflection: Set up short videos about rural revitalization to stimulate student reflection.

Case appreciation: Select representative rural residential project designs for case analysis and discussion. For example, the beautiful village planning and design of "National Beautiful and Livable Village" Lijiazhuang Village. Designers utilize local cultural and natural features to create a unique living space integrating tourism and residence, improving the local people's living environment and economic income, truly making people feel that design changes life.

Class discussion: Analyze the aspects of design implementation for rural revitalization in the case, its characteristics, and whether it meets the requirements of the new era's human settlement environment dream. Summarize the key points of rural residential landscape design under the background of rural revitalization.

Project design practice: Provide topics for rural residential landscape design with regional characteristics for students to choose from.

Firstly, research. Through research, students conduct field investigations to analyze the cultural characteristics and current issues of the base, experience people's lives, understand people's demands through interviews, and lay a factual basis for project design.

Secondly, the design of rural residential landscapes. The main focus is on how to solve the following problems: Continuously improve rural infrastructure construction and significantly improve the rural living environment; Address the hollowing out phenomenon in rural areas; Adhere to the principles of adapting to local conditions and scientific planning, and protect the ecological environment and historical and cultural resources.

Thirdly, design scheme reporting and communication. Guide students to focus on people's needs, identify design positioning around the problems that need to be solved in rural revitalization, elaborate design ideas, improve design schemes, and express their thoughts and solutions on rural revitalization.

Project design reflection: The first is a reflection after each lesson, followed by a specialized comprehensive review and reflection on the scheme after the project design is completed. This guides students to reflect on the deficiencies and optimization directions of the scheme design in terms of meeting farmers' needs and developing the rural economy, further strengthening students' design ability and awareness of "revitalizing the nation and designing for the people."

Assessment indicators: Whether the direction of the rural residential landscape design scheme addresses the issues that need to be solved in rural revitalization and meets the needs of the new era's human settlement environment dream is included in the assessment and evaluation elements, guiding students to establish a design awareness of "revitalizing the nation and designing for the people."

4.3.3. Expected teaching effectiveness

Students are expected to demonstrate the following abilities in the rural residential landscape project design. They can reasonably analyze the SWOT in the project and accurately identify the project positioning that meets the requirements of rural revitalization. In the scheme design, students can practice improving the rural living environment, enhancing farmers' quality of life, and protecting the ecological environment and historical and cultural resources.

4.4. Ideological and political theme 4: Care for low-income people and pursue social fairness and justice

4.4.1. Integration points of ideological and political education

In the context of Theme Unit 4, which focuses on affordable housing landscape design under the dual-track housing system policy, students are prompted to reflect on national conditions, policies, social fairness, people's livelihood, and the responsibilities of landscape designers through case appreciation, project design practice, and reflection. These understandings are then applied to practical project design. Specifically, the following ideological and political elements can be integrated into teaching.

The embodiment of social fairness and justice: Guide students to deeply understand the necessity and importance of implementing the dual-track housing system policy. It embodies social fairness and justice in solving the housing problems of different income groups, enabling a more reasonable distribution of housing resources and meeting the housing needs of low-income groups.

People-oriented philosophy: Affordable housing addresses the basic livelihood issues of low-income groups, with the starting and ending points of safeguarding and improving people's livelihoods, realizing the dream of home ownership for all.

Spirit of responsibility: The construction of affordable housing reflects the country's sense of responsibility towards its people, guiding students to realize that as landscape designers, they have the responsibility and mission to provide safe, comfortable, and livable residential spaces for the people.

4.4.2. Educational methods and carrier pathways

Pre-class reflection: Set up short videos about the dual-track housing system policy to stimulate student reflection.

Case appreciation: Select representative affordable housing community project designs for case analysis and discussion. For example, the landscape design of "Growing City" affordable rental housing in Shanghai adheres to the design concept of caring for low-income groups and ensuring social fairness. The design adopts energy-saving technologies, focuses on human care, promotes a green lifestyle, and creates a living homestead and communal space environment for people.

Class discussion: Analyze the aspects of design that care for low-income groups in the case, its characteristics, and whether it meets the requirements of the new era's human settlement environment dream. Summarize the key points of affordable housing landscape design under the dual-track housing system policy.

Project design practice: Provide topics for affordable housing landscape design with regional characteristics for students to choose from.

Firstly, research. Through research, students conduct in-depth analysis of site characteristics, people's

livelihood demands, etc., laying a factual basis for project design.

Secondly, the design of affordable housing landscapes. The main focus is on how to solve the following problems: Focus on human care to meet the housing needs of low-income groups; Emphasize green, environmentally friendly, and sustainable development. Choose environmentally friendly materials, adopt energy-saving technologies, promote a green lifestyle, and create a healthy, comfortable, and harmonious living environment for residents.

Thirdly, design scheme reporting and communication. Guide students to focus on the needs of low-income people, identify design positioning around the problems that need to be solved in the dual-track housing system, elaborate design ideas, improve design schemes, and express their thoughts and solutions on the dual-track housing system.

Project design reflection: The first is a reflection after each lesson, followed by a specialized comprehensive review and reflection on the scheme after the project design is completed. This guides students to reflect on the deficiencies and optimization directions of the scheme design in terms of meeting the needs of low-income groups, further strengthening students' design ability and awareness of "caring for people and designing for the people."

Assessment indicators: Whether the direction of the affordable housing landscape design scheme addresses the issues that need to be solved in the dual-track housing system policy and meets the needs of the new era's human settlement environment dream is included in the assessment and evaluation elements, guiding students to establish a design awareness of "caring for people and designing for the people."

4.4.3. Expected teaching effectiveness

Students are expected to demonstrate the following abilities in affordable housing landscape project design: They can reasonably analyze the SWOT in the project and accurately identify the project positioning that meets the requirements of the dual-track housing system policy. In the scheme design, students can practice caring for low-income groups, improving the quality of life for residents, and creating a healthy, comfortable, and harmonious living environment for residents.

4.5. Ideological and political theme 5: Technology empowers communities, technology serves the people

4.5.1. Integration points for ideological and political education

In the context of the development of smart technology, as outlined in Theme Unit 5, the landscape design of high-quality smart communities can spark students' reflection on technology's impact on daily life, future communities, and people's future living needs through case studies, project design practices, and reflections. This process aims to inspire students to explore technological innovations and advancements in residential landscape design. Specifically, the following ideological and political elements can be integrated into teaching.

People's livelihood awareness: In community landscape design, smart technology should be utilized to enhance people's quality of life and happiness, fully considering their needs and interests to ensure that technology genuinely brings convenience and well-being to people.

Innovation awareness: With the rapid development of smart technology, landscape designers should continuously explore new technical means and design aspirations, possessing innovative thinking and

capabilities.

4.5.2. Educational methods and approaches

Pre-class reflection: Provide short videos about smart landscape design to stimulate students' thinking.

Case study appreciation: Select representative smart community project designs for case analysis and discussion. For instance, Xiaoshan Guali Colorful Town utilizes smart technology in community building, from Singapore's new towns to Zhejiang's future communities, creating a harmonious smart future community between people, nature, and technology.

Class discussion: Analyze the aspects of smart design featured in the case studies, their characteristics, and whether they meet the requirements of the new era's human settlement environment dream. Summarize the key points of high-quality smart community landscape design in the context of smart technology development.

Project design practice: Offer students a choice of environmentally friendly high-quality smart community landscape designs.

Firstly, research. Through investigations, students will conduct field analyses of the base's characteristics and current issues, understanding people's demands through interviews and other forms, laying a factual foundation for project design.

Secondly, high-quality smart community landscape design. The main focus is on solving the following issues: The humane care provided by smart technology in landscape design, enhancing the convenience and humanity of the living environment; Continuously exploring new concepts and means of integrating smart technology with landscape design.

Thirdly, design proposal presentation and exchange. Guide students to focus on people's needs, centering on technology empowering communities and transforming lives, identifying design positioning, articulating design ideas, perfecting design proposals, and encouraging students to share their thoughts and solutions in smart design.

Project design reflection: Initially, there is a reflection after each lesson. Secondly, a comprehensive review and reflection of the plan are set up after completing the project design proposal. This guides students to reflect on the deficiencies and optimization directions of the smart technology aspects of the plan design, further strengthening their design capabilities and awareness of "technology serving the people."

Assessment indicators: The direction of high-quality smart community landscape design proposals incorporates smart technology, reflecting technology's impact on daily life and aligning with the needs of the new era's human settlement environment dream. These are included in the assessment and evaluation elements, guiding students to establish a design awareness of "technology serving the people."

4.5.3. Expected teaching effectiveness

Students will demonstrate the following abilities in high-quality smart community landscape project design. They can reasonably analyze the SWOT in the project, accurately identifying the project positioning that meets the requirements of smart technology development. In the plan design, they will implement technology to transform lives, explore the integration of smart technology and landscape design, and provide a high-quality living environment.

5. Practical effects of ideological and political education in residential landscape design courses

Through the ideological and political reform of the “Residential Landscape Design” course, the course content is more in line with current trends, and the trained students are more adapted to the needs of social development. By combining online and offline teaching, integrating theory with practice, and adopting teaching methods such as case analysis, discussion, task-driving, and inductive summarization, students are guided to actively consider how to perform their duties as landscape designers. The residential landscape design proposals convey positive values, inherit excellent traditional Chinese culture, promote regional characteristics, meet the growing material and spiritual needs of the people, and create a livable, workable, and travel-friendly living environment for the people. Simultaneously, the course’s project design practices adopt group cooperation, cultivating students’ teamwork spirit and collaboration abilities, laying a solid foundation of comprehensive abilities and professional qualities for students’ transition into society.

6. Conclusion

As society continuously develops, the required abilities of students are constantly evolving. Therefore, the ideological and political construction of residential landscape design will be continuously explored, and the combination of “knowledge guidance and value guidance” is also a continuous long-term task. This article explores the background, overall idea, teaching design, and practical effectiveness of the ideological and political reform of the “Residential Landscape Design” course, aiming to guide students to pay attention to people’s livelihood issues, establish a sense of serving the people, possess the ability to design for the people and assume the responsibility of loving the people. This lays the foundation of knowledge, skills, ideology, and politics for students to better serve society.

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Construction of a Digital Twin Model for Pharmaceutical Education Driven by Transformative Learning — Innovative Practice of Chronic Disease Management Based on the Integration of Short Video, AI, and VR

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Abstract: To address the pain points in pharmaceutical education, such as the shortage of practical teaching resources and inadequate training in complex medication scenarios, this study constructed a three-in-one practical teaching mode for pharmacy, including “short video – virtual simulation – intelligent navigation”. Based on the theories of microlearning and transformative learning, the study innovatively adopted the strategy of “cognitive load optimization + stepped task-driven” approach. The study dismantled the management of five major chronic diseases, including hypertension and chronic hepatitis B, into modular short videos. Additionally, the study introduced cutting-edge topics such as the visualization of the “DFI-DGCF algorithm for medicinal and dietary contraindications.” Through the WeChat public platform, the study established a closed-loop system of “learning – practice – evaluation – application”, integrating AI personalized navigation (recommending learning paths based on learning behavior analysis), VR pharmacy training (simulating 23 types of high-risk scenarios), and blockchain technology for ability certification. Practical application showed that this mode improved students' accuracy in clinical decision-making. The study provided an empirical paradigm of theory-technology-ecology collaborative innovation for the digital transformation of pharmaceutical education. The “three-dimensional and nine-degree” evaluation system and UGC crowdsourcing mechanism constructed in this study offered replicable solutions for the high-quality development of medical education.

Keywords: Short video teaching; Transformative learning; Digital twin; Chronic hepatitis B management; DFI-DGCF algorithm; Digitization of pharmaceutical education

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1. Expansion of the theoretical foundation of the teaching model

1.1. Deepening the application of microlearning theory

Recent research has confirmed that microlearning has unique advantages in improving cognition of medication safety. This model adopts a “knowledge point splitting + instant feedback” strategy, breaking down complex medication knowledge (such as chronic hepatitis B drug resistance management) into 5–8 minute short videos, and embeds instant self-testing sessions. This design aligns with the “cognitive load optimization model” proposed by scholars such as Nurul Fitriah^[1]. Reducing the amount of information inputted at a time increases students’ knowledge retention rate by 37%. Drawing on the experience of Indian pharmaceutical education, the “micro-sitcom” format is introduced in the medicinal and dietary contraindications module to enhance memory anchors through role-playing^[2].

1.2. Practical innovation in andragogy theory

Based on Knowles’ theory, a “transformative learning” mechanism is introduced as follows^[3]. Establish a learner portrait system to push case libraries based on clinical experience differences (e.g., new pharmacists focus on prescription review processes, while senior pharmacists focus on medication consultation strategies); Design stepped challenge tasks, such as setting up a level-based challenge mode in the chronic hepatitis B module, which includes “beginner level – standard treatment review → advanced level – dosage adjustment for renal insufficiency”, aligning with the achievement-driven characteristics of adult learners^[4].

1.3. Scene upgrade based on constructivist theory

Integrating clinical teaching experience from Peking University Health Science Center, a “double-loop learning model” is constructed: the inner loop simulates the HBV virus replication mechanism through 3D animation (using Blender modeling), while the outer loop sets up a virtual patient consultation dialogue system. Through repeated “observation-practice-correction”, students’ clinical decision-making accuracy has increased to 89%, 21 percentage points higher than traditional teaching methods^[5–6].

2. Suggestions for curriculum system optimization

2.1. Dynamic update mechanism for specialized modules

Establish a “guideline monitoring-case iteration” dual channel: Align with the WHO 2023 Guidelines for the Management of Chronic Hepatitis B, add key points for monitoring renal and hepatic toxicity of tenofovir alafenamide (TAF), and update treatment indication standards for adolescents^[7]. Develop a pharmacogenomics topic covering the latest drug-food interaction content such as warfarin-CYP2C9 genotype, allopurinol-HLA-B*5801, and integrate the Wenzhou University DFI-MS prediction model to enhance teaching foresight^[8].

2.2. Expansion of technology integration paths

Constructing a “digital twin” teaching ecology: VR pharmacy training: Introduce the Oubeier virtual simulation system to simulate 23 high-risk scenarios such as special drug refrigeration management and antiviral drug dispensing verification; AI personalized navigation: Based on learning behavior analysis (video pause points, wrong answer clustering), intelligently recommend learning paths, such as automatically pushing the “NSAIDs combination risk” topic for those weak in prescription review; Blockchain

certification: Write prescription review training records into the consortium blockchain, supporting employers to trace ability growth trajectories; Content framework: Starting from five major chronic diseases, including hypertension, hyperglycemia, hyperlipidemia, hyperuricemia, and chronic hepatitis B virus infection, design course modules around five-dimensional abilities.

Four major chronic disease topics: Starting from hypertension, hyperglycemia, hyperlipidemia, and hyperuricemia, design courses around five-dimensional abilities. For example, prescription review: process demonstration, unreasonable prescription case analysis (such as combination use of NSAIDs and diuretics for hypertensive patients). Medication education: Design short videos on communication skills based on patient consultation data (such as purine diet guidance for patients with hyperuricemia).

Chronic Hepatitis B (CHB) Topic: Focus on prescription review, drug resistance monitoring, and patient compliance management of antiviral drugs (such as entecavir and tenofovir). Case design: Simulate medication adjustment scenarios for patients with chronic hepatitis B and renal insufficiency.

Prescription audit: process demonstration and common unreasonable prescription case analysis.

Medication education: Design short videos on communication skills and medication knowledge based on patient consultation data.

Technical Implementation: The practical operation scenes are recorded by a team of senior pharmacists and edited using tools such as Jianying and Premiere, supplemented with graphics and animations to enhance expressiveness. Each video is controlled to be 5–8 minutes long, highlighting key steps and common mistakes. For example, cases such as “dietary interference with prescription rationality” (e.g., high-fiber foods affecting the absorption of levothyroxine) and animations demonstrating the microscopic interaction between drugs and food components in the intestine (such as CYP3A4 enzyme inhibition) are added. Collaborating with the information center, a new AI case generator is added, automatically generating personalized cases based on the WHO 2023 guidelines, strengthening the cognition of antiviral treatment plan updates.

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2.3. Evaluation of teaching effectiveness

2.3.1. Specialized analysis

To evaluate the learning effectiveness of the chronic hepatitis B module, additional assessments such as the “Antiviral Drug Knowledge Test” and “Patient Consultation Simulation Assessment” are introduced. The results show that students’ mastery rate of antiviral drug indications has increased from 65% to 85%, and their familiarity with the drug resistance management process has increased by 30%. The topic of drug-food interactions integrates the mechanism and clinical suggestions for analyzing common drug-food

contraindications (such as warfarin and vitamin K).

2.3.2. Real-life cases

Simulation of patient consultation scenarios (e.g., a patient with chronic hepatitis B inquiring about conflicts between antiviral drugs and a high-fat diet). Hypertension topic: Emphasize the effect of grapefruit juice on calcium channel blockers, supplemented with a short video on the “dietary contraindications list.” Chronic hepatitis B topic: Add a chapter on “Antiviral Drugs and Diet Management” to analyze the relationship between drug absorption and liver function protection.

Qualitative feedback: Student interviews indicate that the “Drug Adverse Reaction Warning” and “Patient Communication Skills” modules in the short videos on chronic hepatitis B are the most practically valuable, helping them reduce the risk of medication errors in real scenarios.

Improvement of quality evaluation system; construct a “three dimensions and nine degrees” evaluation model: To evaluate the learning effectiveness of the chronic hepatitis B module, additional assessments such as the “Antiviral Drug Knowledge Test” and “Patient Consultation Simulation Assessment” are introduced. The results show that students’ mastery rate of antiviral drug indications has increased from 65% to 85%, and their familiarity with the drug resistance management process has increased by 30%. The topic of drug-food interactions integrates the mechanism and clinical suggestions for analyzing common drug-food contraindications (such as warfarin and vitamin K).

3. Improvement of quality evaluation system

The “Three Dimensions and Nine Degrees” evaluation model was constructed in **Table 1**.

Table 1. “Three Dimensions and Nine Degrees” evaluation model

Dimension	Evaluation indicators	Data sources
Knowledge Construction	Conceptual mastery/clinical reasoning/guideline compliance	Online tests, case analysis reports
Skill Development	Prescription review speed/communication effectiveness/resilience	AI conversation logs
Vocational Qualification	Ethical decision-making/interdisciplinary collaboration/continuous learning	360-degree evaluations, learning archives

Drawing on the clinical pharmacy evaluation experience from Shandong University, a fuzzy comprehensive evaluation method is employed to process qualitative indicators, and the entropy weight method is used to determine the weight of each indicator, ensuring that the error rate of evaluation results is controlled within $\pm 5\%$ ^[9].

4. Innovation in social service extension

Public science communication matrix: Develop a “Drug-Food Risk Quick Check” mini-program that integrates the DFI-DGCF graph neural network algorithm. The public can input drugs to obtain a visual map of forbidden foods.

Grassroots empowerment plan: Conduct live teaching on standardized treatment for chronic hepatitis B via WeChat live broadcasts, covering 132 county-level hospitals in central and western regions.

Policy response mechanism: Translate the requirements of the National Health Commission's "Opinions on High-Quality Development of Pharmaceutical Services" into teaching standards. For example, add a "long-term prescription management" scenario drill to the medication instruction module.

5. Sustainable development strategy

Content co-creation ecology: Establish a user generated content (UGC) course development platform where clinical pharmacists can upload practical cases (subject to review by the PCNE classification system). Excellent cases will be awarded continuing education credit hours.

Cross-institutional collaboration Network: Join the National Pharmaceutical Professional Degree Online Education Alliance to share 57 quality course resources and establish a credit mutual recognition mechanism.

Diversified revenue model: Develop customized training products for pharmaceutical companies (such as post-market monitoring of innovative drugs), which will feed back into teaching resource updates, achieving an annual self-sustaining funding rate of $\geq 65\%$.

6. Conclusion

Through theoretical, practical, and ecological innovations, this study constructs a digital teaching paradigm that meets the transformation needs of pharmaceutical services. In the future, the authors will further explore the construction of a metaverse teaching space, realizing multi-agent collaborative training among "pharmacists, patients, and AI assistants" to provide talent support for the "Healthy China 2030" strategy.

Disclosure statement

The author declares no conflict of interest.

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Research on the Approach of Character Education in Kindergartens from the Perspective of Home Co-education

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Abstract: Early childhood is the key period to cultivate good character. As an important model of early childhood education, home co-parenting has a non-negligible impact on the formation of young children's character. This paper aims to explore the effective approach of character education for children from the perspective of home co-parenting. Through analyzing the connotation of home co-education, the present situation and challenges of children's character education, this paper puts forward some strategies, such as strengthening home communication and cooperation, innovating education methods, and establishing incentive mechanisms, to provide beneficial reference for children's character education.

Key words: Home co-breeding; Young children; Character education; Access

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1. Introduction

The Family Education Promotion Law of the People's Republic of China, promulgated in 2021, states that "primary and secondary schools, as well as kindergartens, should invite relevant personnel to impart family education concepts, knowledge, and methods according to the needs of parents, organize and carry out family education guidance services and practical activities, and promote joint education between families and schools"^[1]. Character education for young children is of great significance for their comprehensive development. However, traditional education models often overlook character education and overly focus on the cultivation of knowledge and skills. The rise of the homeschool co-education model has provided new opportunities for character education in young children. The close cooperation between family and kindergarten, as the main environment for children's growth, is crucial for salvaging their good moral foundation and shaping their good behavior. In addition, in October 2022, the report of the 20th National

Congress of the CPC stressed that educators should improve the social education mechanism of schools and families. In the context of the new era, to form high-quality character education for young children, more attention should be paid to the collaborative education between home and school, and based on this, new paths and directions for scientific and efficient character education for young children should be expanded ^[2].

2. The significance of homeschool co-education and early childhood character education

2.1. The Importance, connotation, and value of character education for young children

Character is mainly reflected in the integration of a person's basic qualities, including personal temperament, temperament, moral literacy, values, and other aspects. American psychologist Thomas Rickner believed that "character is integrated into moral life to reflect the integrity of character practice, and good character is composed of knowing good, wanting good, and doing good." The early childhood stage is not only a golden period for promoting physical and intellectual development but also an important period for establishing good character. This shows the importance of moral education for the comprehensive development of young children. Character education rich in educational value will have a significant impact on students' character development. The early childhood stage is a critical period for forming good ideological and moral values. Character education can help children lay a solid foundation of character, which is beneficial for their future life development ^[3]. Character education aims to cultivate excellent qualities such as honesty, trustworthiness, gratitude, and helpfulness in young children, which have a profound impact on their future growth and development. In early childhood education, character education is equally important, and even more crucial, as it relates to the formation of children's moral cognition and behavioral habits.

Childhood is a critical period for character formation, and character education can help children shape good personalities, such as honesty, courage, kindness, and self-discipline. These traits will accompany them throughout their lives and influence their behavior and interpersonal relationships. Character education emphasizes respect and a sense of responsibility towards others. Educating young children to care for and be willing to help others can cultivate their sense of social responsibility and lay the foundation for them to become responsible members of society. Through character education, young children can gradually understand and identify with social moral norms, improve their moral cognition level, learn to distinguish between good and evil, and distinguish right from wrong to make correct moral judgments and behavioral choices in daily life. Character education is closely related to the cognitive, emotional, and social development of young children. Good character helps children to be more confident, proactive, and active in learning, life, and interpersonal communication, achieving comprehensive development ^[4]. The character traits and moral concepts formed during early childhood will have a profound impact on their future outlook on life and values. Good character education can lay a solid foundation for young children's lives and help them maintain a resilient spirit when facing challenges and difficulties.

2.2. The connotation and value of homeschool co-education

Homeschool co-education refers to parents and kindergartens working together to complete the education of young children. In the process of early childhood education, both families and kindergartens regard themselves as the main body to promote the development of young children. Both parties are proactive, understanding, supportive, and cooperative, and they synchronize education with each other, forming an

educational synergy to promote the comprehensive development of young children. From the perspective of homeschool co-education, character education for young children is no longer solely the responsibility of kindergartens but requires joint efforts from families and kindergartens to shape good character in young children.

Homeschool co-education helps promote the comprehensive and harmonious development of children's physical and mental health. Homeschool co-education can help young children develop good living and hygiene habits, improve their self-protection ability, and form beneficial lifelong living abilities and civilized lifestyles. Helps young children develop good learning qualities such as being proactive, serious and focused, not afraid of difficulties, daring to explore and try, and willing to imagine and create. It can greatly promote the good social development of young children, making them feel a sense of security, trust, happiness, family, and friendship. Carrying out parental work is a compulsory course for every preschool teacher, and the success of various forms of home activities also reflects the level of the teachers' work ability. Parents have a better understanding of their children's temperaments, personalities, and interests than teachers and have accumulated certain experiences in educating their children. Teachers can enrich their own educational methods by communicating with parents and drawing on their educational experience. By participating in kindergarten activities, parents can further understand the educational and teaching work of the kindergarten, especially have a more comprehensive understanding of their children's development. Parents can gain practical knowledge, skills, and strategies for educating young children by participating in various activities organized by the kindergarten through communication with teachers, gradually changing their own educational concepts and behaviors, and enhancing the confidence of educating young children. Fully utilizing educational resources and forming an educational synergy, the complementary educational advantages of kindergartens and families are conducive to the full utilization of educational resources. Parents cooperate with kindergartens to cultivate children's self-care abilities, teachers respect and understand parents, and both parties work together for the healthy growth of children. Through homeschool co-education, parents and teachers can achieve information sharing and smooth communication, jointly providing suitable learning resources and activities for young children to meet their learning needs and improve their learning outcomes.

3. The current situation of character education for young children from the perspective of homeschool co-education

3.1. Low parental involvement

Although more and more parents are paying attention to character education for young children, the actual participation rate is still not high. Some parents believe that character education is the responsibility of kindergartens and lack awareness and action to provide character education for young children at home. In addition, due to busy work and other reasons, parents often find it difficult to participate in character education activities organized by kindergartens ^[5].

3.2. Poor communication between home and school

Homeschool communication is the foundation of homeschool co-education, but in practical operation, there are often problems with poor communication between home and school. On the one hand, kindergarten teachers may lack effective communication skills and methods with parents; On the other hand, parents may not have sufficient understanding of the educational philosophy, curriculum, and other aspects of

kindergarten, which can lead to difficulties in forming consensus and collaboration in educating children's character.

3.3. Lack of resources for character education

From the perspective of homeschool co-education, character education for young children requires abundant educational resources to support it. However, at present, there is still a lack of resources for character education in homeschool co-education. On the one hand, kindergartens may lack systematic character education courses and textbooks; On the other hand, parents may lack scientific parenting knowledge and methods, making it difficult to provide effective character education for young children at home.

4. The implementation path of preschool character education from the perspective of homeschool co-education

4.1. Establish an effective communication mechanism

Establishing an effective communication mechanism is the key to character education for young children from the perspective of homeschool co-education. With the rapid development of information technology, it has become possible to use information technology to promote home interaction. Kindergartens can establish online platforms or application software to provide parents with resources and guidance related to character education. Parents can learn about the educational philosophy, curriculum, and teaching methods of kindergartens through online platforms. At the same time, parents can also communicate in real-time with teachers through online platforms to jointly pay attention to the development of children's character. Kindergartens should maintain close contact with parents through various channels, such as holding regular parent meetings, establishing parent mailboxes, utilizing information technology, etc., to timely understand the performance and needs of children in the family, and jointly develop targeted character education plans. At the same time, kindergartens should strengthen guidance and training for parents, improving their understanding and participation in character education.

4.2. Utilizing information technology to promote homeschool interaction

Carrying out homeschool interactive activities is an important way for children's character education from the perspective of homeschool co-education. Kindergartens can organize parent visit days, parent classrooms, parent-child activities, etc., to allow parents to have a deeper understanding of the kindergarten's educational philosophy, curriculum, and teaching methods and to enhance their trust and support for the kindergarten. At the same time, through these activities, parents can better understand the performance and needs of their children in kindergarten and work together with teachers to explore strategies and methods for character education. These measures not only allow parents to participate in the character education of young children at home but also help strengthen communication and cooperation between home and school and improve the enthusiasm and effectiveness of parents' participation in character education.

4.3. Building common values and educational philosophies

Building common values and educational concepts is the core of character education for young children from the perspective of homeschool co-education. Families and kindergartens should jointly clarify the goals and content of character education and form a unified educational philosophy. Only under the guidance of

common values and educational concepts can families and kindergartens work more closely together to promote the character development of young children ^[6].

To this end, kindergartens can organize activities such as expert lectures and parent seminars to guide parents in establishing correct parenting concepts and methods. At the same time, kindergartens should strengthen daily communication with parents, timely understand their confusion and needs in parenting, and provide targeted guidance and support for teachers.

4.4. Clarify the role positioning of homeschool co-education and build a unified moral education environment

Parents and kindergartens should jointly shoulder the responsibility of character education for young children and clarify their respective roles in the construction of a moral education environment. As the first people responsible for the growth of young children, parents should establish correct educational concepts, actively participate in character education for young children, and especially create an environment conducive to character development for young children in the family. Kindergartens should provide rich character education resources and activities for young children and work together with parents to create a moral education environment that is conducive to the development of children's character.

4.5. Strengthen the construction of the teaching staff

Teachers are important implementers of character education for young children. From the perspective of homeschool co-education, kindergartens should strengthen the construction of their teaching staff and improve their understanding and implementation ability of character education. On the one hand, kindergartens should organize teachers to participate in character education training and learning exchange activities to enhance their professional competence and educational level. On the other hand, kindergartens should also establish a scientific teacher evaluation system and incentive mechanism, encouraging teachers to continuously innovate and practice in character education.

4.6. Design scientific educational content and adopt diverse educational methods

Parents and teachers should fully tap into the educational resources of families and schools, integrate high-quality content, and provide rich and diverse character education materials for young children. A series of themed character education content can be established in conjunction with educational objectives, such as Integrity Month, Responsibility Week, etc., allowing children to experience and feel character education in themed activities. At the same time, diversified educational methods should be adopted, such as setting up life-oriented and situational activities, allowing children to experience character education through practical operation and interaction, and cultivating good qualities.

4.7. Establish evaluation and feedback mechanisms and adjust educational strategies in a timely manner

The implementation of character education for young children from the perspective of homeschool co-education also requires the establishment of effective evaluation and feedback mechanisms. By observing and evaluating the development of children's character, problems can be identified promptly, and corresponding measures can be taken to solve them. At the same time, it is also necessary to regularly provide feedback to parents on the development of children's character, discuss and solve existing problems together with

parents, promote close cooperation between home and school, and jointly promote the comprehensive growth of children.

4.8. Emphasize cultivation education and strengthen practical experience

Character education for young children should focus on cultivating education, guiding them to develop good behavior habits and character through daily practice. By implementing practical activities such as water conservation and environmental protection, educators aim to cultivate children's environmental awareness and sense of responsibility; Cultivate children's love and gratitude awareness through parent-child reading, family activities, etc. At the same time, parents and teachers should encourage young children to constantly try and explore in practice, gradually forming good character through self-management and self-restraint.

The implementation path of character education for young children from the perspective of homeschool co-education requires the joint efforts and support of parents, kindergartens, and all sectors of society. By clarifying role positioning, strengthening communication and collaboration, designing scientific educational content, emphasizing cultivation education, and establishing evaluation and feedback mechanisms, educators can create a more conducive educational environment for children's character development and help them grow up healthily.

5. Conclusion and suggestions

5.1. Conclusion

Homeschool co-education is crucial for character education in young children. Early childhood character education is a complex and systematic project. As two important places for early childhood character education, families and kindergartens share the responsibility of cultivating good character in young children and have a positive promoting effect on their development. By establishing effective communication mechanisms, conducting homeschool interaction activities, building common values and educational concepts, strengthening the construction of teaching staff, utilizing information technology to promote homeschool interaction, and emphasizing evaluation and feedback, the comprehensive development of children's character can be effectively promoted.

There are still shortcomings in the current homeschool co-education. At present, some parents attach more importance to the cultivation of children's knowledge and skills while neglecting the improvement of their children's character. At the same time, some preschool teachers rarely actively communicate with parents to avoid an increase in workload, which makes it difficult for parents to understand the true performance of their children in kindergarten, their character situation, and their ability to cultivate their children's character in a targeted manner in daily life.

5.2. Suggestion

Strengthen communication and cooperation between home and community. Kindergartens should establish multiple communication channels and strengthen daily contact and communication with parents. At the same time, parents should actively participate in kindergarten activities and educational processes and jointly pay attention to the development of children's character. Enhance parental involvement. Kindergartens should enhance parents' awareness and participation in character education through organizing parent training, parent classrooms, and other activities. At the same time, parents should also strengthen their own learning

and master scientific parenting knowledge and methods. Enrich character education resources. Kindergartens should develop systematic character education courses and textbooks. At the same time, parents should also provide their children with rich resources for character education, such as picture books, audio-visual materials, and so on. Strengthen the construction of the teaching staff. Kindergartens should strengthen character education training and learning exchange activities for teachers. At the same time, establish a scientific teacher evaluation system and incentive mechanism to encourage teachers to continuously innovate and practice in character education. Utilize information technology means. Kindergartens should fully utilize information technology to promote homeschool interaction and resource sharing. At the same time, parents should actively use information technology to participate in the character education of young children.

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The Application of Ceramic Art in Cultural and Creative Product Design in Northern Guangdong: A Case Study of the Shixia Culture

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Abstract: In recent years, with the rapid development of the social economy, the living standard of the public has been effectively improved, as the people are no longer limited to the pursuit of material level and can be more focus on spiritual and cultural pursuit. The emergence of cultural and creative product design can effectively meet the spiritual and cultural needs of the public, the effective integration and dissemination of ceramic art, cultural and creative products, and Shixia culture. In addition to enriching and improving the content and expression of cultural and creative product design, enhancing the unique novelty of the product, it can also promote the promotion, dissemination, and development of Shixia culture to make the public deeply understand the charm of Shixia culture. In this regard, this paper takes Shixia culture as an example, firstly expounds the application principles of ceramic art in the design of cultural and creative products, and then puts forward the application path of ceramic art in the design of cultural and creative products, to provide some reference and reference for relevant researchers.

Keywords: Ceramic art; Cultural and creative product design; Shixia culture; Application

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1. Introduction

Shixia culture, a bright pearl inlaid in the late Neolithic Age in southern China, has not only left a strong mark on the picture of history with its unique charm of ceramic art and decorative style, but also become an endless source of inspiration in the field of modern cultural and creative design^[1]. In exploring the journey of integrating this ancient wisdom into modern life, designers shoulder a dual mission: to dig deep into the essence of Shixia culture, skillfully integrate the unique language of its ceramic art, and create excellent cultural and creative works that not only carry the profound historical background but also adhere to the contemporary aesthetic trend^[2]. At the same time, they need to carefully consider the practicality and user experience of the product to ensure that each work is not only a piece of art but also a small and practical

companion in life. It is not only a dialogue between tradition and modernity but also a tribute and continuation of the vitality of Shixia culture. Through such cross-border integration of design practice, people can not only make the traditional culture in the digital era, but also feel the charm and temperature that spans thousands of years in daily life, so that the ancient civilization continues to shine on the stage of modern society, so that every consumer can experience the beauty of cultural inheritance and innovation in daily use ^[3].

2. The application principle of ceramic art in cultural and creative product design

2.1. Principles of innovative design

To apply ceramic art to Shixia cultural and creative products, designers need to make innovative use of Shixia cultural elements. Creativity is the key to the design of cultural and creative products, which is directly related to whether it can seize the appeal of consumers. If Shixia cultural and creative products lack creativity, it is difficult to have a relatively strong competitiveness ^[4]. Therefore, designers should have the courage to break through the conventional design concept, closely around Shixia culture, creative and application of ceramic art, and under the premise of inheriting and carrying forward Shixia culture, use new design forms to express ceramic art, so that Shixia culture will glow with new vitality. For example, when designing the cultural and creative products of Shixia culture related to the theme of ceramics, designers can not only fully explore the patterns in ceramic art and Shixia culture patterns but also make creative application of modern technology ^[5]. Taking 3D printing as an example, through the customization of different types of cultural and creative products, the direct processing of complex components can be realized, and the problems in their shape and structure can be quickly detected. With the help of this technology, designers innovatively design the shape of ceramic cultural and creative products, flexibly apply various ceramic art elements in different regional locations, and realize the close combination of Shixia culture and modern elements ^[6].

2.2. Practical design principle

The application of ceramic art in the design of Shixia cultural and creative products should not only consider the cultural experience and aesthetic needs of consumers comprehensively, but also pay attention to the practicality of cultural and creative works, which can meet the daily use needs of consumers, especially the creative design of cultural and creative products related to ceramics ^[7]. At the same time, designers need to integrate ceramic art with Shixia culture, take practicality as the premise, and better apply it to the design of cultural and creative products. At the same time, they also need to innovate modern technology skills so that consumers can resonate at the ideological and emotional level, enhance their identification and ownership of Shixia culture, and also make the practical function of cultural and creative products more perfect ^[8]. Based on the innovative design form of ceramic art and culture, restore and retain the property and practical function of ceramic cultural and creative products, and finally present in front of consumers in a unique form, and promote the innovative inheritance and development of Shixia culture.

2.3. Cross-border integration and the principle of multiple experience

In the field of cultural and creative product design, cross-border integration has become a trend. The combination of ceramic art and Shixia culture should not be limited to a single form or field but should explore cross-border cooperation with other art forms, such as digital art, fashion design, traditional handicrafts, and so on, to create diversified cultural experiences ^[9]. For example, interactive ceramic

installation art can be designed to allow consumers to experience the historical story of Shixia culture through AR technology while visiting the exhibition or cooperate with a fashion brand to launch a limited-edition ceramic accessory series, incorporating traditional cultural elements into modern fashion trends. This cross-boundary attempt can not only enrich the expression forms of cultural and creative products but also broaden the channels of cultural transmission and attract a wider audience ^[10]. At the same time, paying attention to the principle of multiple experiences is also the key to enhancing the appeal of cultural and creative products. In the digital age, users' demand for product experience is no longer limited to vision or touch, but a comprehensive and multi-sensory immersive experience. Therefore, in the design process, every detail of user experience should be fully considered, and a variety of elements such as sound, light and shadow, touch, and even emotional resonance should be combined to create a unique interactive experience.

2.4. Principles of cultural inheritance and sustainable development

Integrating ceramic art into the design of cultural and creative products is not only a combination of aesthetics and practicality but also a kind of inheritance and development of traditional culture. As a treasure of Chinese civilization, Shixia culture, with its unique artistic style and historical value, has provided rich creative materials and sources of inspiration for ceramic art. Therefore, in the design process, the principles of cultural inheritance and sustainable development must be followed. When learning from the cultural elements of Shixia, researchers should respect its historical background and cultural connotation, re-interpret and creatively express it through modern design techniques, so that the traditional elements are presented in a novel and vivid way, which not only retains the original cultural flavor, but also gives it a sense of the time. Considering the resource consumption and environmental impact in the ceramic production process, the concept of environmental protection should be integrated into the design, and sustainable materials and processes should be adopted, such as the use of waste ceramic fragments for re-creation, to reduce resource waste, while improving the added value of products, and passing on the concept of green life ^[11]. For example, the North of Guangdong Tea Picking Opera is a national intangible cultural heritage project, designs can be tall and short step, cloud hand, touch step, fan flower, solo dance, dance to dance and other art forms, reflected in the ceramic cultural and creative works, cultural and creative products are not only commodities, but also the carrier of cultural communication. Through the application of ceramic art in cultural and creative products, the public's knowledge and understanding of Shixia culture can be deepened, the spread and popularization of culture can be promoted, and cultural self-confidence can be enhanced ^[12].

3. The application path of ceramic art in cultural and creative product design

3.1. To uphold cultural values and enhance the core values of cultural and creative products

To design Shixia cultural and creative products based on ceramic art, designers should effectively integrate modern aesthetic elements with Shixia culture, which can not only enrich the cultural connotation of cultural and creative works but also meet the aesthetic needs of contemporary consumers. For example, the designer uses the typical patterns of Shixia culture, such as squares, curves, and swirly patterns, to design a series of pottery, cultural, and creative products ^[13]. These cultural and creative products not only integrate the features of ancient Shixia culture in shape, such as geometric patterns and animal totems in Shixia culture, but also innovate in function, making them both aesthetic art and having practical value. For example, when designing

cultural and creative products of tea sets, designers can integrate totem elements of Shixia culture into the pot lid, which can not only make the cultural and creative works more cultural connotation, but also its practicality will not be interfered with. In addition, designers can also design and develop series of ceramic cultural and creative products such as pen holder and bookmark based on Xia cultural characteristics. In addition to maintaining the original characteristics and cultural heritage of Shixia culture, the integration of ceramic art can make the products more exquisite and durable and meet the needs of consumers' cultural and creative needs, to promote the inheritance of Shixia culture in a new way. It can also make more and more consumers feel the unique charm of Shixia culture. Or, as one of the typical patterns of northern Guangdong and southern Pai Yao, the horse head pattern often uses red, yellow, white, green, and other colors to appear on clothing in the form of regular two-side continuous scattered organization. Designers can apply clothing patterns to the shape of pottery and cultural products to better display national cultural characteristics. In addition, when promoting these cultural and creative products, designers can use the Internet, offline displays, and other ways so that more and more consumers know and fall in love with Shixia culture; at the same time, they can also enjoy the unique charm of Shixia culture when shopping. In this way, designers can keep the value of Shixia culture, continuously improve the market value of Shixia cultural ceramics and products, and promote the inheritance and development of Shixia culture.

3.2. To encourage cross-border cooperation and continuously enhance the value of brand IP

Cross-border cooperation should be emphasized in the design of Shixia cultural and creative products to effectively improve its brand value. For example, the designer and major fashion brands jointly launched the Shixia culture theme clothing, the ceramic pattern, color and other elements into the clothing, which not only reflects the unique charm and charm of our national culture, but also can effectively attract young consumers; In terms of tourism, the designer relies on Shixia culture and develops tourism souvenirs in combination with the characteristics of Maba People site, so that tourists can get a unique cultural experience and drive the development of local cultural tourism. In the design of the ancient village of Shitang in northern Guangdong Duihua rice wine bottle, Shuangfengzhai architectural components can be integrated into the ancient ancestral hall wall painting, ancient residential doors and windows carving, ancient building Ma Tou wall decoration, and other cultural elements. In the field of education, designers can integrate Shixia cultural elements into the ceramic pen holder so that students can feel and learn Shixia culture in the process of application, strengthen their cultural identity awareness, and strengthen the protection of Shixia culture. In addition, Shixia cultural ceramic products are also promoted through digital means, such as the development of relevant mobile phone applications, online games, and virtual reality experiences, so that the traditional culture can be presented to the public in a more vivid form. Shixia cultural cross-boundary cultural and creative product design based on ceramic art greatly improves the popularity of Shixia culture, creates new business opportunities for Shixia cultural and creative products, and also provides strong support for the continuous value-added of its brand IP. At the same time, Shixia cultural ceramic products can also be combined with a modern art exhibition. Through the form of art exhibition, Shixia culture and modern art dialogue, the public can appreciate the art while also have a deep understanding of Shixia culture^[14]. Such cross-border cooperation can not only enhance the popularity of Shixia culture but also stimulate the public's interest and curiosity in traditional culture, thus promoting the inheritance and innovation of culture. Through continuous exploration and practice, Shixia

cultural ceramics and creative products are gradually becoming a bridge connecting traditional culture and modern life, opening up a new path for the inheritance and innovation of traditional culture.

3.3. To use digital technology to design multi-dimensional ceramic cultural and creative products

Through digital technology, Shixia pottery cultural and creative product design has realized multi-dimensional innovation. First, using 3D printing technology, designers can combine traditional patterns with modern design concepts to create pottery works with a unique style. These works not only retain the traditional charm of Shixia culture but also meet the aesthetic needs of modern consumers. Secondly, through augmented reality technology, consumers can integrate virtual pottery works with the real environment through the camera of their mobile phones or tablets and experience unprecedented interactive fun. In addition, Shixia Culture has developed an online interactive platform where users can customize personalized pottery products, from selecting patterns to customizing shapes, making the whole process both convenient and fun. These digital means not only broaden the sales channels of Shixia pottery products but also greatly improve the user experience so that traditional culture can be integrated into modern life in a more user-friendly and fashionable way. In addition, in terms of the application of digital technology, the design team of Shixia Cultural ceramic cultural and creative products actively embraces new technologies, such as augmented reality and virtual reality, to provide consumers with an immersive cultural experience. For example, through AR technology, consumers can use their mobile phones or tablets to scan specific ceramic cultural and creative products, thus seeing three-dimensional animations or stories related to Shixia culture on the screen, which not only increases the interactivity of the products but also deepens consumers' understanding of Shixia culture. In addition, the application of VR technology allows users to experience a virtual visit as if they were in the site of Shixia Culture, a brand new way of experience that greatly enhances the attractiveness and educational significance of the products.

3.4. To create sustainable cultural and creative products by combining the concept of environmental protection

In Shixia Culture's creativity and design of cultural and creative products, deeply integrating the concept of environmental protection has become the essence of its future development strategy. The designers dare to explore, actively use biodegradable mud, recycled ceramic raw materials and other environmental protection materials, and strive to significantly reduce the environmental burden in the production process. With ingenuity, they have designed a series of ceramic artworks with recycling characteristics, such as a modular reconfigurable tableware series and a pen holder with multiple functions, aiming to stimulate consumers' awareness of recycling and significantly reduce resource consumption and waste. In addition, promoting the culture of "green consumption" has become another important strategy, aiming to guide consumers to choose cultural and creative goods that are both creative and meet environmental protection standards, and jointly promote the sustainable development of society. Take tea set design as an example; the selection of environmentally friendly ceramic raw materials and the product packaging eye-catching display of its environmental certification logo, to attract those environmentally conscious consumer groups^[15]. For the horse-head-patterned ceramic cultural and creative products of Paiyao in the north and south of Guangdong, designers can use degradable ceramic materials, combined with modern environmental protection concepts, to design ceramic tea sets that both have national characteristics and conform to modern environmental protection trends. These tea sets not only

integrate the pattern of the horse head in appearance but also innovate in function, such as designing stackable tea cups, which is convenient for storage and space saving while reducing the use of ceramic products, reflecting the concern for the environment. In addition, through the promotion of the online platform, designers can convey the concept of environmentally friendly ceramic products to consumers and encourage consumers to choose these cultural and creative products that are both beautiful and environmentally friendly, thus promoting the whole society's attention and practice of environmental protection ^[16]. Through these measures, Shixia culture not only shows respect for and protection of the environment but also integrates green thinking into every cultural and creative product, creating an eco-friendly cultural and creative treasure that is both beautiful and practical and contributes to the sustainable development of society.

4. Conclusion

All in all, the application of ceramic art in the design of cultural and creative products, especially the integration of Shixia culture, can not only promote the inheritance and development of Shixia culture but also stimulate design innovation and inject new vitality into the development of the modern cultural and creative industry. This requires designers to dig deep and make reasonable use of traditional cultural resources such as Shixia culture, which can provide more abundant and diversified materials for cultural and creative product design and promote the integration and development of traditional culture and modern design. In this regard, designers can enhance the core value of cultural and creative products by keeping the cultural value, encouraging cross-border cooperation to continuously enhance the value of brand IP, and using digital technology in the multi-dimensional ceramic art creation product design. Combining the concept of environmental protection and creating sustainable cultural and creative products and other strategies can organically integrate ceramic art, cultural and creative products, and Shixia culture, and effectively improve the cultural heritage and artistic appreciation of cultural and creative products.

Disclosure statement

The authors declare no conflict of interest.

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